# SECTION 14.0 CERAMICS MANUFACTURE AND USE

## INTRODUCTION

Ceramics, as an artifact class, contain a wealth of valuable information for the interpretation of a site, as they functioned within not only the economic realm, but also within the social and ceremonial realms as well. Ceramic analysis can offer information to address questions related to chronology, subsistence, manufacturing technology, mobility, and social identity. In addition, detailed study of ceramic patterning relates to concepts of discard behavior, possible reuse, and site formation processes.

Excavations at the Hickory Bluff Site resulted in the recovery of one of the largest ceramic assemblages from controlled excavation in Delaware. A total of 7,625 sherds were recovered; 1,591 of which measured greater than 2 centimeters (cm) in diameter (included in detailed analyses). The analysis of this ceramic collection was designed to answer questions of vessel manufacture, including sourcing of temper and inclusions, vessel use, distribution, and chronology. The analysis was undertaken with the use of vessel lots, rather than individual sherds, to provide a more even and consistent description of ceramic frequencies. A detailed description of this methodology is located in Section 12.0 and comprehensive results are presented in Appendix I. In addition to the comprehensive data collected from the identification of the individual ceramic lots, two specialized analyses were conducted for small samples of the ceramic assemblage to determine petrographic composition and function. A thin section analysis was conducted on 33 ceramic sherds to examine variations in the selection of clay and temper through time. Two ceramic sherds exhibited residue that was examined to determine function and identify subsistence resources.

The information gathered from the ceramic assemblage was vast and presented a unique opportunity to study the formative period of ceramic manufacture in this region. The analysis added information that may be used in future research to resolve larger regional questions that persist concerning the evolution of ceramic manufacturing technology over time and how it related to the changing social dynamics and life-styles of the peoples utilizing these wares.

## MANUFACTURING ATTRIBUTES AND SOCIAL SIGNATURES

Ceramics are extremely important because they were created and functioned within the social realm of the people who produced them. Their function could range from everyday household activities such as food preparation or storage, to more ceremonial and symbolic roles. Aside from the functional categories interpreted for ceramics that inform on social activities, the ceramics themselves can often be utilized to infer social boundaries. Group preferences and ideas are reflected in ceramic manufacture, which may foster or hinder changes over time.

### Decorative Motifs

The trait most commonly utilized to establish group identities was decorative motif. Decorations differ from surface treatments, as they represent an intentional, aesthetic design unrelated to the manufacturing process, despite often being made with the same implements. The range of common decorative motifs include: cord marking (more systematically placed then usual surface treatments), incising, punctation, impressing, perforating, or applique (the addition of molded clay designs) (Sinopoli 1991). On prehistoric vessels, formal decorations were usually restricted to the vessel rim and the upper portions immediately adjacent to the rim. These patterns likely carried symbolic or ceremonial meanings for the makers and users of the ceramics. Studies of the range of designs have been used as a means of identifying group affiliation, with the same designs or similar motif elements thought to represent a common group or cultural affiliation. Social status, religion, or familial ties may all be expressed by chosen decorative motifs. However, using decoration to make such distinctions requires a large comparative data set and knowledge of the relations between motifs.

Only three of 86 vessel lots from Hickory Bluff exhibited formal decorations. These were Vessel Lots MO1, T1, and, MI1. Vessel Lot MO1 was decorated on the rim with impressed parallel single cords. The cords were so fine that they initially appeared like incised lines. These cords were spaced 4.0-8.0 mm apart and angled diagonally up toward the rim edge. On two mended sherds, there was evidence of at least nine impressions or lines, impressed across areas that had previously been finger-swiped. The attention to detail displayed in the impressed single cord decoration was reminiscent of Townsend incised parallel lines.

The decorations observed on Vessel Lot T1 were consistent with Townsend decorations. Townsend ceramics commonly have elaborate decorative motifs that ranged from the simple to the complex. The interior of the rim edges was impressed with a cord-wrapped stick, which was arranged vertically with a slight tilt. The impressions were separated by only 1.0-2.0 millimeters (mm) at the edge and created a wavy effect on the thin rim edges. The cordage utilized for the decoration was fine and had a Z-twist.

Like Townsend ceramics, Minguannan ware often exhibited complex rim decorations and decorative motifs. Vessel Lot MI1 was decorated with parallel lines of impressed cords that encircled the rim in a basically horizontal manner, with a slight angle to the rim edge. The lines were approximately 2.0 mm apart and were evenly and carefully spaced. They were composed of a fine cord of Z-twist cordage, with segments 3.0 mm in length and approximately 1.0 mm wide.

The relative lack of formal decoration on the vessels of the Hickory Bluff assemblage was not unexpected. The majority of the vessel lots represented Early and Middle Woodland wares, which typically do not contain elaborate decorative motifs. Two of the three vessels that exhibited formal decoration (Vessel Lots T1 and MI1) were Late Woodland.

The lack of formal decorations at Hickory Bluff does not imply that the vessels were plain. Quite the contrary, as many of the vessels evidence extensive surface treatments that included deep net impressions and cord-marking on Clay Tempered vessels, cord-marking on Wolfe Neck, cord-marking and fabric impressions on Hell Island vessels, cord and net impressions on Mockley vessels, and net impressions on Popes Creek. These surface treatments are not regarded the same as formal decorations, as they are more related to the functional process of forming and shaping ceramic vessels and do not show the same level of detail in their placement. However, it is likely that differences within surface treatments were important and communicated meanings to the group in similar ways as more formal decorations. These differences could be expressed in the type of cordage used to impress the pots or the level of smoothing or scraping evident on the body surface.

Another aspect of ceramics often overlooked in terms of decorative quality is the type of temper and inclusions contained in the paste. Temper and inclusions, depending upon their type, can influence the color and general appearance of vessel. Although regarded as generally functional (temper) or part of the clay source (inclusions), temper choices and clay selection (with specific inclusions) could also be made based on how the appearance of the vessel may be altered. For instance, Vessel Lot MA06 contained a higher content of iron oxides within the paste relative to other vessels, which contributed a distinctive pinkish color to the vessel. Vessel Lots MA04, MA08, and MA09 were tempered with steatite and dark schist, which created a glistening effect to the vessel surfaces. Similarly, Vessel Lots H1, H2, and H4 contained mica temper/inclusions within the paste in addition to quartz temper material, which created a distinctive appearance for the Hell Island ware. Concepts of color were important to Native American groups and bearing that in mind when examining ceramic collections devoid of formal decorations might provide suggestions of group affiliation or symbolic meaning to the peoples producing and utilizing the vessels.

The use of decoration to define stylistic classifications has resulted in its use as the basis for interpretations of ceramic distribution. When a particular decorative type is found outside of its normal range, it is often interpreted as a sign of trade, copying, or “female capture” (Chilton 1998: 132). Critics have begun to argue that too much emphasis has been placed upon decorative motifs, which “has inhibited a deeper understanding of the technological and social contexts of ceramic manufacture and use” (Chilton 1998: 132). This is partly true as a result of the limited portion of a vessel that is decorated (i.e., only the rim), which ignores the greater part of both the individual vessel and the majority of a given assemblage. Utilizing technological attributes allows for a more inclusive ceramic study and gives attention to the process of manufacturing as much as to the final product. Research is beginning to demonstrate that the process and techniques used in ceramic manufacture, rather than the end shapes and appearances, are more indicative of the group producing the ceramics, and less likely to change in short time intervals (Chilton 1998). Thus attributes of the production process such as the surface treatments present and characteristics of the cordage utilized on the vessel may be more indicative of group affiliation than decorative motifs, which are not present on all vessels and tend to change over shorter time spans.

## Surface Treatment

Manufacturing methods can also be identified in the impressions left on the interior and exterior surfaces of the vessel. Impressions may include marks made from the end of a paddle used for shaping purposes, fabric impressions from the mats the vessel was formed on, indentations or channels from the smoothing process, or a variety of scrape marks from various tools used. The deepness of the surface impressions may also indicate group preferences; some may carefully smooth vessels to erase most signs of manufacture, while others may pattern and deeply impress surfaces. The angles (wide or right) and types of coil joints (i.e. overlapped, elbow, etc.) may also be determined and indicative of the normative manufacturing process for the group. However, surface treatment types may also be related to intended vessel function, and therefore are not the most reliable social signature on their own.

Surface treatments among the Marcey Creek vessels were relatively consistent. All 12 vessel lots contained smoothed plain walls on the both the interior and exterior surfaces. Vessel Lot MA06, however, evidenced some light scraping on its interior surface. In addition, eight of the 12 vessel lots contained impressions of mats on their bases, presumably from when they were formed. These impressions showed a mild degree of variability, with Vessel Lot MA12 displaying deeper impressions than other lots and with a more close-weave fabric. Vessel Lot MA07 was also deeply impressed, but with a thicker fabric/mat. A similar thick mat was observed from the impressions on Vessel Lot MA04. The similarity of the surface treatments among the Marcey Creek vessel lots suggested a degree of standardization in their manufacture.

The two Dames Quarter vessel lots displayed different surface treatments in the represented sherds. The Vessel Lot D1 sherd was smoothed plain on both the interior and exterior surfaces, in much the same way as the Marcey Creek vessel lots. One of the sherds in Vessel Lot HD1 was cord-impressed on one surface and plain on the other surface.

The Wolfe Neck vessel lots displayed a degree of standardization for exterior surface treatments and variability for interior surface treatments. Five of the six vessels displayed cord-impressed exterior surfaces that extended to the lip edge. Vessel Lot W4 was slightly different, showing impressions of a cord-wrapped paddle that extended to the lip edge and some faint paddle markings. On the interior surfaces, four of the vessels had cord impressions that ranged from faint to smoothed over, these were Vessel Lots W2, W3, W4 and W5. Each showed variation in the amount of finger swiping or paddling that was used to smooth over the interior. Vessel Lots W1 and W6 had smoothed plain interior surfaces and evidence of criss-cross scrape marks that left rows of narrow parallel lines in the surface. The degree of difference in the surface treatments was not substantial, but did illustrate some variety and may possibly indicate group preferences in manufacturing techniques.

The two vessel lots of Popes Creek ceramics displayed similar exterior surface treatments and slightly different interior surfaces. Vessel Lot P1 had net impressions on the exterior surface and a faintly scraped interior surface. The exterior net impressions of Vessel Lot P2 were deeper than Lot P1 and its interior surface was smoothed with faint earlier impressions evident. The sample size was relatively small but showed similar treatments, with the difference lying not in the treatments but the rather the application of those treatments.

Clay Tempered ceramics had two main differences in their exterior surface treatments: cord-marking or net-impressions. Of the 41 Clay Tempered ceramic lots, 17 cord-marked and 24 net-impressed were identified. Within the cord-marked Clay Tempered ceramics, differences were noted in the deepness of the impressions and the amount, if any, of smoothing the impressions. Vessel Lots CC01, CC05, and CC12 were deeply cord-impressed in comparison to the other vessels, and Lots CC01 and CC05 also displayed a small degree of smoothing of these marks. Smoothing was also noted on Vessel Lots CC02, CC03, CC10, and HCC1, while evidence of scraping in the form of narrow parallel striation marks was seen on Vessel Lots CC01, CC03 and HCC1. The interior of the cord-marked vessel lots also displayed a variety of different treatments. Five vessel lots showed cord-markings on the interior: Vessel Lots CC01, CC07, CC11, CC13 and HCC1. Thirteen of these vessels displayed either smoothing or scraping, and in many cases a variety of both on the interior surfaces. The scraping left patterns of fine, narrow, parallel lines. Vessel Lot CC09 had its interior surface net-impressed and then smoothed over, which was unique.

The net-impressed Clay Tempered wares also evidenced some variation in the degree of the impressions on the exterior surfaces. Of the 24 vessel lots, 15 were described as deeply net-impressed or net-roughened and displayed highly patterned surfaces. Four were described as lightly to moderately net-impressed with partial smoothing. The remaining five vessel lots were just plainly net-impressed. The interior surface treatments also displayed degrees of variation. Eight vessel lots displayed net impressions or faint net-impressions still on the interior, and one, Vessel Lot CN15, was deeply net roughened with no subsequent smoothing on the interior which was unique. Evidence of both smoothing and scraping was the most common interior surface treatment, observed on 11 vessel lots within the net-impressed Clay Tempered vessels. Smoothing was found on nine vessel lots, while scraping was found on just three vessel lots. Vessel Lot CN21 was unique and showed incomplete smoothing and finger depressions on the interior surface.

The range of treatments observed on both the exterior and interior surfaces within and between the cord-marked and net-impressed varieties of Clay Tempered ceramics was significant. It showed a less strict adherence to accepted manufacturing rules and may relate to group preferences or individual expression. The cordage used for the various cord-marking and net impressions also displayed some variety, which will be discussed below in the cordage section. These differences could also relate to functional differences between these vessels or could carry deeper symbolic meaning for the makers of these ceramics. The differences noted also highlighted the degree of variation that was present within types recovered at the site.

The Mockley vessel lots showed variations of both exterior and interior surface treatments. Five of the nine vessel lots had net impressions on their exterior surfaces, including Vessel Lots MO2, MO3, MO4, MO7, and MO8. Within these five vessels, differences were noted in the net impressions. Vessel Lot MO3 was repeatedly impressed or net-roughened and Vessel Lot MO2 was highly patterned, while Vessel Lot MO8 had its impressions partially smoothed over. The other four Mockley vessel lots, MO1, MO5, MO6, and HMO1 were impressed with cordage and also showed slight differences. Vessel Lot MO1 showed vertical finger swiping in addition to the cord marking. Vessel Lot MO6 was impressed vertically to the rim edge, while Vessel Lot HMO1 had its cord-markings partially smoothed over. The interior surface treatments displayed even more variety. Vessel Lots MO4, MO5, and MO6 were simply smoothed. Vessel Lots MO2 and MO3 were scraped, with Vessel Lot MO3 evidencing repeated scrapings pattern of fine criss-crosses at different angles. Vessel Lots MO1, MO7 and MO8 showed signs of both smoothing and scraping. Vessel Lot MO1 had fine parallel scrape marks running both vertically and horizontally across its interior, while Vessel Lot MO7 was barely smoothed and had developed a groove from the scrapings. Finally, Vessel Lot HMO1 had been cord-marked on the interior with no smoothing. The degree of variation between the Mockley vessel lots was interesting and suggested a less formalized adherence to manufacturing rules, and might reflect personal or group preferences of style. The differences might also have functional or symbolic meanings expressed in the different choices of surface treatments.

Differences were noted for the both the exterior and interior surface treatments of the four Hell Island vessel lots. Vessel Lot H1 had a fabric impressed exterior surface treatment and a smoothed interior that showed faint striation marks. Vessel Lot H2’s exterior had a narrowly spaced criss-cross pattern created with a cord-wrapped paddle and a smoothed plain interior. The exterior surface of Vessel Lot H3 was also cross-paddled with a cord-wrapped paddle that covered to the rim edge, while its interior surface was smoothed and scraped, which left narrow striations. Vessel Lot H4 was missing its exterior surface and had a cord-marked interior surface treatment. The variety of the treatments between these lots suggested a less strict manufacturing technique and a possible group preference or functional advantage for the different techniques.

The Townsend vessel lots displayed more similarity of surface treatments relative to the other wares. All of the vessel lots had exterior surfaces that were fabric impressed, and only one was then scraped over (Vessel Lot HT1). The interior surfaces of Vessel Lots T1 and T2 had been smoothed plain. Vessel Lots T3 and HT1 had been scraped on the interior and had patterns of criss-cross narrow parallel lines evident. These slight differences showed a small degree of variation within an otherwise strict manufacturing style. However, the sample was small and may have evidenced greater diversity with a larger sample.

The remaining vessels represent single examples and thus do not provide much comparative information. Vessel Lot MI1 had the same treatment on its exterior and interior surfaces, which was smoothed with faint drag marks evident. Vessel Lot HUT1 had an exterior surface impressed with a close-weave fabric and a smoothed interior surface. Vessel Lot UT1 had a lightly cordage-impressed exterior surface with a smoothed interior surface that showed faint impressions. Vessel Lot HSH1 had smoothed over unidentifiable impressions on the exterior surface and a scraped interior surface with narrow parallel markings evident. The exterior surface of Vessel Lot S1 was incompletely smoothed with faint impressions, while its interior surface was smoothed. Vessel Lot S2 was deeply net-impressed on the exterior surface and lightly net-impressed and smoothed on the interior surface. Although they do not represent specific types, these examples helped to illustrate the variation of surface treatments present in the assemblage and were factors that separated these vessel lots from the more traditional types.

The information gathered from the surface treatments of the vessels in the assemblage was important. It highlighted important concepts of stylistic adherence as well as localized or individual expression. Slight differences in surface treatments could evidence a variety of different situations including group preferences or functional differences for various surface treatments. The differences may also carry symbolic meaning for the peoples who created them, which are not evident to us at this time. The study of surface treatments helped to define specific vessel lots and highlighted the benefits of a more inclusive ceramic study based on manufacturing attributes over decorative motifs.

## Cordage

An important technological attribute in ceramic manufacture to analyze is the type of cordage (if any) used to mark the vessel. Patterning within the cord and fabric impressions observed on ceramic sherds was recognized as early 1884 when W.H. Holmes made cast impressions of ceramic sherds and identified differing cord construction techniques (Hurley 1979). Later researchers began to quantify and more fully describe the different techniques used to construct cordage and fabrics. Studies have demonstrated that “the possible manipulations of cordage by prehistoric peoples are limited only by their imaginations” (Yoshizaki 1979 in

Hurley 1979: vi). Consequently, observed similar patterns among cordage impressions of a ceramic assemblage might be used to infer group identity. Cordage patterns tend to stay consistent within groups, and when changes are observed within an assemblage, it is often a good indicator of change at the site, either from group movement, or overwhelming influence from an outside source (Maslowski 1996).

Cordage can be constructed in a variety of ways from the very simple to the complex. Each ply or element that produces the cord may have different twists at each stage, which are difficult to identify due to the often weathered condition of ceramic sherds (Hurley 1979). The "final twist" is often the only identifiable pattern that remains and the one most widely described. Twisting patterns can be described as a "Z" or "S" twist, which denotes the slant of the segments: upper right to lower left (Z) or upper left to lower right (S) (Hurley 1979). Assemblages are usually dominated by one or the other, which is culturally specific, as there is no functional difference between the types of twist (Maslowski 1996). Twist patterns remain more consistent and resistant to change over time than other decorative motifs employed. This consistency is a result of the "highly standardized, culture-specific motor habits" employed to construct cordage (Maslowski 1996: 89). However, it would be highly unusual for any assemblage to consist of only one twist-type. The minority twist-type present is usually within the standard deviation that could be expected from either handedness of the producer or idiosynchratic behavior. Cordage twist patterns can also be helpful in determining associations when more than one ceramic technology is found at a single site.

After the basic final twist is established and the frequencies by ware are ascertained, a more systematic examination of the cordage was undertaken to identify variety. Number of segments, thickness of cords, and the comparison of single cord to net and/or fabric impressions are important for interpretations about ceramic vessel use (e.g., elaborate treatments or cordage used for certain vessels and not for others of the same basic ware type). Such differences may be related to vessel function (either cooking or storage), or may relate to utilitarian use as opposed to those with more symbolic and ceremonial use. These interpretations could also be supported if examinations demonstrated that the vessels exhibiting the "minority twist" in an assemblage were also somehow different from the rest of the ware type, either by fineness of fiber or by other construction characteristics – size, temper type, surface treatment. Being aware of these different variables may help to establish patterns of correlation between them and enhance interpretations of both vessel and site function.

Final twist for cordage was identified on 53 of the 86 vessel lots in the Hickory Bluff assemblage, which represented 62 percent. Where twist was identified, 45 vessel lots (85 percent) exhibited S-twist cordage, while only 8 (15 percent) had Z-twist cordage (Table 14.1). Given the predominance of Early Woodland and early-Middle Woodland wares in the assemblage, this majority of S-twist cordage was not unexpected. A trend has been noticed across the Mid-Atlantic region whereby S-twist cordage tends to dominate Early and Middle Woodland ceramic types. It is not until the late Middle Woodland and Late Woodland periods that Z-twist cordage is more prevalent. The continuity of twist cordage was not necessarily an indication of relatedness between the peoples producing the various ware types. However, when Z-twist cordage becomes the dominant cordage characteristic, it is a clear sign that change has occurred at the site. This change might have been the result of population movement or some overwhelming influence from an outside area. The Hickory Bluff assemblage generally followed this same pattern and does not contain many Z-twist cordage vessels until the later types are encountered (i.e., Hell Island, Townsend, and Minguannan).

**Table 14.1 Hickory Bluff Ceramic and Cordage Types**

| Ceramic Type | Identified S-Twist | Identified Z-Twist |
|---|---|---|
| **Marcey Creek** | 0 | 0 |
| **Dames Quarter** | 1 | 0 |
| **Wolfe Neck** | 4 | 1 |
| **Popes Creek** | 0 | 0 |
| **Clay Tempered Ware** | 29 | 2 |
| **Mockley** | 7 | 0 |
| **Hell Island** | 2 | 1 |
| **Townsend** | 0 | 2 |
| **Minguannan** | 0 | 1 |
| **Untyped** | 2 | 1 |
| **Total** | 45 | 8 |

Within the Marcey Creek and Dames Quarter vessels, information regarding cordage was limited, due to the plain surface treatments associated with these wares. Although mat impressions were identified on eight of the vessel lots, cordage characteristics could not be identified. The mat impressions on Vessel Lot MA01 showed thin woven elements in the mat, but final twist could not be identified. Vessel Lot MA12 had mat impressions that were created with a close-weave fabric, but again final twist could not be determined. The mats used to impress both Vessel Lots MA04 and MA07 were described as thick and suggested a coarser woven fabric. Vessel Lot D1, which represented the Dames Quarter type, contained no impressions on its surfaces, while Vessel Lot HD1 had one sherd that displayed a cord-impression of S-twist cordage.

The cordage for the Wolfe Neck vessel lots consisted of four S-twist cordage, one Z-twist cordage, and one unidentified. The Z-twist cordage was identified on Vessel Lot W4, and this was rare for Early Woodland ceramic types. No ceramic assemblage of a given ware usually contains all one type of twist, owning to differences in the handedness of the potter or other idiosyncrasies. Therefore the identification of this minority vessel was interesting given the lower frequency of Wolfe Neck vessels. Vessel Lot W6 also contained interesting cordage characteristics. Although the final twist could not be determined, at least two different cords that varied in thickness were identified. Some of the cords appeared flat and perhaps untwisted. This vessel displayed variation within the type and illustrated a range of difference that could be present.

Both Popes Creek vessel lots were net impressed, but cordage twist could not be identified on either vessel lot. Vessel Lot P1 had net impressions that were formed with a net that was widely spaced. The openings in the net were from 4.0-6.5 mm apart. No further information on cordage could be determined for the Popes Creek ceramics.

Within the Clay Tempered ceramics, cordage could be identified on 31 of the 41 vessel lots (76 percent). S-twist cordage was identified on 29 (94 percent) of the vessel lots, while Z-twist was identified on two vessel lots. The Z-twist cordage was identified only on cord-marked Clay Tempered ceramics, specifically Vessel Lots CC04 and CC12. In both vessel lots, the cordage seemed to be twined into a loose fabric, although the small sizes of the sherds made a definitive assessment impossible. Additional differences were noted on the Clay Tempered cord-marked vessels. A total of seven vessel lots were noted as having impressions of loosely twined fabric. Vessel Lot CC06 contained fine cordage that was wrapped in irregular intervals across the surface. Vessel Lot CC07 had fine to medium sized cordage. A range of cordage thicknesses was also observed in Vessel Lot HCC3. Untwisted open flat fibers were visible on Vessel Lot CC08 in addition to S-twist cordage.

The Clay Tempered net-impressed vessel lots also displayed variety in the identified cordage characteristics. Five vessel lots were identified as having tightly spaced knots in the net arrangement, while seven were considered to be loosely spaced or wide net patterns. Fine and thin cordage was identified on four vessel lots within the Clay Tempered net-impressed varieties. Vessel Lot CN04 was unique in that it appeared to be formed by knots joining double cords that gave the vessel lot a distinctive appearance. Vessel Lot CN03 was also unique in that the surface treatment was formed with an unidentifiable stiff element worked into the netting, whereas the rest of the collection typically displayed more simple net or fabric impressions. The range of variation within the cordage characteristics displayed by the Clay Tempered vessel lots was important as it highlighted the variability that was present within ceramic types.

Seven of the nine Mockley vessel lots displayed S-twist cordage, with the cordage indeterminate on the other two vessel lots. The cordage used on Vessel Lots MO4, MO5, and MO6 varied in thickness from very fine, 0.5 mm, to 1.5-2.0 mm on these vessels. Vessel Lot MO2 was marked with very fine cordage that was woven into a tightly spaced net and left a highly patterned surface. No further cordage information was available for the other vessel lots. However, the differences noted in these examples illustrated the range of types of cordage present, which could relate to either functional or symbolic attributes of the vessels, as different attention to detail was evident on the vessels.

The Hell Island vessel lots displayed diversity in their cordage attributes. Two of the four vessel lots (H2 and H4) were impressed with cordage formed with an S-twist, while only one vessel lot displayed Z-twist cordage (H3). The twist on Vessel Lot H1 could not be identified but it was fabric impressed with a close-woven fabric of thin and fine cordage. Vessel Lot H2 also displayed very thin and fine cordage that had been closely wrapped around the paddle used for the surface treatments. Vessel Lot H3, which displayed Z-twist cordage, exhibited fine cords that were wrapped with irregular degrees of separation, some wider and some very close. The cordage used on Vessel Lot H4 was medium sized, and it was unclear if it was woven into a fabric or wrapped around a paddle. The range of variation displayed within the cordage of the Hell Island vessel lots showed diversity within the type.

Within the Townsend ceramics, cordage could only be confidently identified on Vessel Lot T1. This vessel lot had very fine and tightly woven fabric formed with Z-twist cordage. Vessel Lot T3 was also fabric impressed with cordage tentatively identified as Z-twist, but the highly weathered surface prevented a definitive assessment. Fabric impressions were also identified on Vessel Lots T2 and HT1, although the twist could not be identified. The cordage used on Vessel Lot T2 was fine and closely woven. The Townsend vessel lots displayed some slight differences in cordage and more importantly, illustrated the change to Z-twist cordage in the Late Woodland types.

The other Late Woodland type was represented by Minguannan Vessel Lot MI1. This vessel had cordage identified as finely woven and formed with a Z-twist. Although only a single vessel, it follows the trend noted in Late Woodland cordage being formed with a Z-twist.

Among the Untyped vessel lots, cordage characteristics varied. Vessel Lot UT1 was impressed with cordage that may have been woven or twined into a loose net or fabric. Its thickness varied from 0.5 mm to 2.0 mm and it was formed with a final S-twist. Vessel Lot HUT1 had cordage identified as finely woven with a Z-twist. Vessel Lot S2 was net impressed, with a net formed with S-twist cordage. No cordage information could be identified on Vessel Lots S1 or HSH1, as both vessels had been smoothed to an extent that made identification of the surface treatment impossible.

The range of cordage characteristics displayed within the Hickory Bluff ceramic assemblage was significant. The assemblage corroborated the general trend noted on the Mid-Atlantic region, whereby S-twist cordage dominates types until the Late Middle Woodland. Within the types however, the cordage varied from loosely twined and coarse cordage to very fine and closely woven fabrics. These differences suggested that differing levels and attention to detail occurred between vessels. These differences could represent preferences between groups producing the vessels, functional differences for the vessels, or more symbolic meaning to the producers of the ceramics.

## VESSEL FUNCTION

The function of a ceramic vessel is a fundamental question that requires a detailed set of vessel attributes to answer. This is the case because small differences in visual characteristics may reflect much larger differences in function, vessels may serve multiple purposes throughout their use life, and a vessel may contain manufacturing features that are not related to its intended use (Orton et al.1993; Sinopoli 1991). Vessel function can be divided into three broad categories: storage, processing, and transfer. Although no one ceramic trait can be reliably used to indicate vessel function, a reasonable assertion of vessel function may be made by observing the overlap and correlation between technological attributes such as form, temper and use wear.

### Vessel Form

Vessel form is often one of the first traits observed and used to interpret function, as the shape of a vessel is considered to be related to its intended use. Vessels with rounded bases are more efficient as cooking vessels, as they tend to distribute heat more evenly, easily, and are less susceptible to thermal stress than flat-bottomed vessels (Sinopoli 1991). Stresses tend to concentrate along the angles of flat-bottomed or angular vessels (Orton et al. 1993). Other attributes such as volume, stability, aperture, and the location of the center of gravity may all be influenced by the intended function of a vessel (Sinopoli 1991). Thickness of vessel walls may also relate to function; thicker-walled vessels are more resistant to breakage and thus, are considered useful for storage or transport; while thin walls transfer heat more readily and are useful for cooking (Orton et al. 1993). However, vessel function is not the only factor that influenced shape, as it "is also determined by normative ideas, fashions, and the technology of ceramic production" (Sinopoli 1991: 84).

Data related to vessel form was limited within the Hickory Bluff ceramic assemblage due to its fragmentary nature, as with most assemblages. The Marcey Creek vessel lots contained the most information related to vessel form. Of the 12 lots, nine had flat-bottoms, considered typical for the ware. Two vessel lots had no information available, while Vessel Lot MA02 had a probable conoidal shape. This shape is atypical for Marcey Creek ceramics but is a diagnostic attribute of steatite tempered Selden Island ware. The sherds of MA02 were smoothed rather than cord-marked, however, unlike Selden Island ware, and therefore were grouped with Marcey Creek despite the variation in vessel form. One Wolfe Neck vessel, W3, displayed a typical conoidal shape, but no information was gathered from the other vessels. Within the Clay Tempered vessels, three contained evidence of conoidal body shape: HCC4, CN10 and HCN2.

## Vessel Thickness

Vessel wall thickness was calculated for each vessel lot in the assemblage, when available. The values were obtained by averaging the range of thickness for each measurable sherd within a vessel lot; use of average measurements served to smooth out some of the differences that would be expected for different portions of the vessel (e.g., sherds closer to the base would be thicker than those near the rim). The average thickness provided a rough indication of relative durability in the absence of more data on vessel size and shape. However, without more information about vessel size, sherd thickness may be misleading, as there is no way to know the thickness to vessel size ratio (i.e., do certain vessels have thinner walls relative to larger size).

Average vessel thickness varied both between and within types. Thickness ranged from a minimum of 4.5 mm for Vessel Lot UT1 to a maximum of 14.5 mm for Vessel Lot MO7, with an overall average of 9.48 mm and standard deviation of 1.95. Thickness was not available for two Vessel Lots, H4 and P2.

Comparison of the thickness of each vessel by type revealed both clustering and divergence between wares (Figure 14.1). There was overlap among the wares, but the general trend illustrates that vessel thickness tends to decrease for later wares (Hell Island, Townsend, and Minguannan), although the sample size for these types was small. The one divergent Hell Island vessel (9.0 mm) was Lot H3 that showed other traits divergent from other Hell Island vessels. Interestingly, the thickest vessel represented was a Mockley vessel (MO7), while as a ware Mockley clustered more toward the median of the range, 8.25-10 mm. Clay Tempered ceramics had the greatest range of thickness and also tended to be the thickest as a ware. The Clay Tempered wares also displayed a fair amount of standardization, as many of the vessel lots clustered together around 9 mm and also 11 mm. Marcey Creek ceramics clustered around 9.3-9.83 mm, with outliers at 8.07 mm and 12.85 mm. The two Dames Quarter vessels were within the same range of thickness as the Marcey Creek vessels. Wolfe Neck ceramics also showed a fair amount of clustering, with four vessels within the range of 7.83-8.5 mm thick. The degree of overlap evidenced by the different wares was important and suggested a continuity of vessel size. This overlap was most evident for the Clay Tempered vessels that by having the widest range of thickness, tended to overlap with most of the other ceramic types.

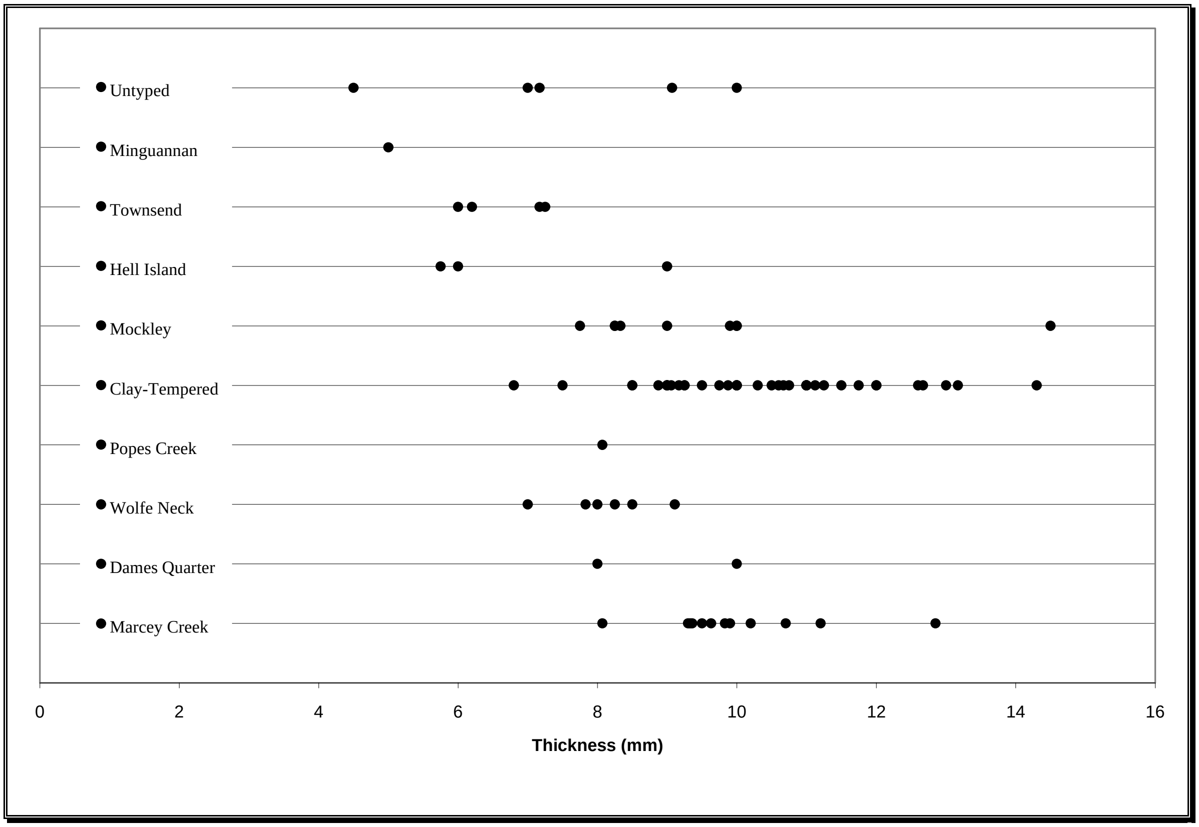


**Figure 14.1 Comparison of Hickory Bluff Vessel Thickness by Ceramic Type**

## Volume

Volume data were calculated for two vessels based on Mounier's formula of *Volume = 0.533 x Diameter*$^3$ *+/- 27 percent* (Liebeknecht et al. 1997: 9-22). Vessel Lot HCC4 had a capacity of 11.7 liters or 3.1 gallons. The volume calculated for Vessel Lot HCN2 was 9.4 liters or 2.8 gallons. These volumes suggested a large capacity for these two vessels. Due to the fragmentary nature of the assemblage, however, comparisons of the volumes with other vessels were not possible.

## Temper Type

Another manufacturing attribute that can be related to vessel function is temper, both type and amount. Different types of temper materials are more well-suited for specific functions. Because clay is not a good conductor of heat, vessels are susceptible to thermal stress from repeated firings. To reduce this stress, temper materials may be added that have similar expansion rates as clay when heated, for example, calcite, feldspars, and hornblende (Sinopoli 1991). Other common temper materials, such as quartz and other crushed rock, have a rapid expansion rate, and would produce stress within the vessel with repeated heating. The number and size of pores within the paste are also important for thermal stress, as more and larger pores have a tendency to slow cracking and spalling from repeated heating. To increase the porosity of a vessel without changing the clay source, organic materials can be added which burn during the firing process, leaving voids within the paste. Conversely, factors beneficial for reducing thermal stress are often less advantageous for mechanical and sudden stresses, for instance, stacking or dropping. Increased porosity and the use of tempers that expand like clay usually undermine the overall strength of a vessel, whereas tempering agents such as quartz, sand and other coarse materials, serve to increase the durability of the vessel to abrasion and sudden shocks (Orton et al. 1993). Therefore, by examining the type and density of temper and inclusions, a determination may be made regarding the function for which each vessel is most well-suited. However, there are examples of vessels used for purposes that would seem contradictory to their physical properties, for example, thick-walled, quartz-tempered cooking vessels.

Seven different tempering agents were used in the manufacture of the 33 prehistoric ceramic sherds: crushed quartz (769-3, 918-3, 1413-1, 2306-1, 2780-1), steatite fragments (859-1, 966-1, 2163-1, 2319-1, 3589-2, 3962-1, 4048-2, 4466-1), sand (978-1*, 1207-1, 1466-1, 2774-2, 2833-1, 3587-1, 4344-1), shell fragments (4042-3, 4277-1), carbonate rock fragments (1326-1), fragments of fired ceramics (688-1, 978-1*, 2129-1, 2378-3, 4415-1, CX107-N), and fragments of unfired clay (262-1, CX107-FF). Sherds 740-1, 2255-1, and 3623-4 were manufactured without the addition of tempering agents. Of these tempering agents, all but the steatite would have been locally available for use by the potter. The source of steatite quarries is the Piedmont, located further inland from the site vicinity. However, steatite for use as temper could be scavenged or recycled from earlier steatite bowls for local ceramic vessel manufacture.

Within the sub-samples represented by sherds tempered with the same material, the relative density, size, and roundness of temper varied a great deal. These variations were attributed to several causes: degree and nature of processing, degree to which tempering agents were incorporated into the clay matrix during manufacture, and the specific requirements of the manufacturing process.

### Temper Processing

The degree and nature of processing was important for explaining the variations in temper size and roundness. In the case of tempering agents created by crushing or pulverizing (rock fragments, steatite, quartz, grog, shell), the variability in size and roundness of temper within and between vessels may be the result of incomplete processing. Materials were crushed to the point where the largest fragment remaining in the pile was considered manageable for the manufacture process, but no further attempt was made to sort the fragments for a consistent size. Due to their relative hardness, and presumed difficulty in processing, rock fragments, steatite, and quartz tended to exhibit a greater variation in size, with grains in any given sherd ranging from powder (<0.1mm) to fragments that were visible in hand specimen (2.0-3.0 mm). Grog and shell, as more easily friable materials, appeared to have been processed to a lesser extent, such that fragments of these materials exhibited less variation in size. Sand, in contrast, required little processing prior to use, apart from cleaning or winnowing to remove organic or rock fragments. As a result, sand grains were more consistent in size and roundness when compared to the crushed tempers. In the case of unfired clay, it was likely that the fragments were incorporated into Samples 262-1 and CX107-FF by accident, rather than intention. This hypothesis was supported by the roundness of the fragments (clay spalls or small balls) and by the fact that the fragments were the same composition as the matrix of the vessels into which they were incorporated.

The degree to which tempering agents were incorporated into the clay matrix during manufacture and the specific requirements of the manufacturing process both related to the density or amount of temper and the selection of the type of temper used in a particular vessel. Unfortunately, the density of temper observed in the cross-section of a single vessel fragment cannot be assumed to be representative of the density of temper throughout the entire vessel. Depending on how extensively the clay was worked prior to shaping the vessel, the temper might be consistently distributed throughout the vessel, or might form pockets or concentrations. The forming of pockets would be accentuated if the temper were being added to a clay body with many natural inclusions. Similarly, the actual shaping process could function to redistribute inclusions such as temper, with thinner portions of the vessel being likely to exhibit a greater density of temper versus matrix and thicker portions exhibiting a lower temper to matrix ratio. The density of temper in a given vessel was the choice of the potter, who added a specific amount and type of temper to each vessel depending on the firing properties of the clay body, the structural requirements of the vessel, and the particular firing technology to be used (drying, low firing temperature, high firing temperature, fuel, and venting).

**Use Wear**

Vessels can also be examined for use wear patterns that related to their function. Patterns of discoloration or soot may develop on the base and/or bodies of vessels used repeatedly for heating or cooking purposes. For example, vessels placed directly into a fire, among the coals, will develop an area of sooting around the lower portion of the body, but not directly on the base, whereas vessels suspended above fires will develop a buildup of soot around the entire lower surface including the base (Orton et al. 1993). However, careful attention must be maintained, as some differences in body color may also result from the initial firing process of manufacture. Evidence of scraping or mixing related to food preparation may be found as scratches in the interior base and sides of a vessel (Sinopoli 1991).

In addition, organic residues may adhere to the surfaces of the ceramic or be absorbed into the porous paste. These residues can be analyzed chemically to possibly determine their origin and may imply a partial function of the vessel. Determining the actual materials that left a residue from their constituent acids and compounds, identified by residue analysis, is often difficult. Certain compounds may deteriorate at different rates, change composition over time, or be completely absent by the time they are examined (Orton et al. 1993). The context of the vessel is also important for residue analysis. Vessels may absorb residues from the soil they are found in over time, particularly in midden or trash pit features, which contain an abundance of organic material.

A total of 17 vessel lots (20 percent) within the assemblage showed evidence of heating or cooking related alterations. The evidence ranged from light smudging or darkening to deeply darkened and/or reddened with evidence of residue build-up. These signs of heat alteration were found on representatives of Marcey Creek, Wolfe Neck, Clay Tempered, Mockley, and Hell Island ceramics. No evidence of heat alteration was noted on the Late Woodland wares, the

Popes Creek, or Dames Quarter vessels; however, fewer vessels of these types occurred in the assemblage.

Heat alterations were evident on four (33 percent) of the Marcey Creek vessel lots. Vessel Lot MA01 showed a deep darkening at the center of the interior of its base. This discoloration was even across this area of the vessel, which suggested it was heat induced. Vessel lot MA01 was slightly redder on the exterior base surface than on the rest of the vessel. In addition, darkening was found about 10 cm below the rim on the exterior of Vessel Lot MA02. A slight darkening was also found on the interior of several sherds within Lot MA06, suggestive of heat related activity. Vessel Lot MA11 showed deeply darkened interior walls and basal sherds, also suggesting heat alteration.

There was only one (17 percent) example of heat alteration among the Wolfe Neck vessels. Vessel Lot W4 contained a faint to light smudging of the interior surface near the rim. This darkening was not well-defined on this vessel and could not be clearly tied to function.

The Clay Tempered ceramics displayed the widest range of visible heat alterations that were found on a total of 10 vessel lots (24 percent). Vessel Lot CC06 had a darkened rim interior that was lightly smudged, while Vessel Lot CC12 exhibited heavier darkening and smudging on a sherd. Heavy residue build-up was evident on Vessel Lot HCC4; this lot also displayed brighter orange-red colors near its base and a distinct darkening of the surfaces near the rim. Vessel Lot CN01 had light to heavy smudging that was found primarily on the interior surfaces, but also noted on some exterior surfaces. The deep smudging on this vessel suggested direct cooking or a heat related function. Darkening at the rim and reddening at the base indicative of heating was observed on Vessel Lot CN02. A deep darkening and smudging was also found on the interior of at least eight sherds of Vessel Lot CN07, which displayed a darker interior than exterior surface. Vessel Lot CN10 was lightly smudged along the rim on both the interior and exterior surfaces, and had a thick build-up of residue. Some exterior and possible interior smudging was noted on Vessel Lot CN20. This vessel had a redder exterior surface that was darkened in the smudged areas. Vessel Lot HCN1 was smudged on its interior surface, while Vessel Lot HCN2 exhibited darkening and light smudging on both the interior and exterior surfaces at the rim. The wide range of heat alterations evidenced among the Clay Tempered vessels suggested different functions or heating techniques. The various discolorations and residues were indicative of direct heating or use as cooking vessels.

Among the Mockley vessel lots, only Vessel Lot MO8 exhibited evidence of heat alteration (11 percent). This evidence was in the form of a distinctive dark smudging on the interior surfaces of the vessel. This vessel lot also had a heavy residue build-up, suggesting that its use for either heating or cooking related activities.

A single lot of Hell Island ceramics exhibited evidence of heat alteration (25 percent). Vessel Lot H4 had an interior with a darkened, reduced surface and a highly oxidized exterior surface. This distinctive coloration of the vessel helped to distinguish it from the other vessels in the assemblage.

Evidence of use in the form of markings and scrapings was inconclusive for the vessels in the assemblage. Although many vessel lots displayed evidence of scraping with a comb-like tool, the scrapes appeared to be related to forming and shaping the vessel rather than use. Specifically, scraped impressions were present within the paste, sometimes smoothed over, which suggested that they were created before firing the vessel, hence, before its actual use. Some evidence of scraping was likely lost as sherds of the vessel eroded and weathered over time, especially as such markings would be light and on exposed surfaces.

**Residue Presence**

At Hickory Bluff, 19 sherds were recovered that contained residues on their surfaces. These sherds were from eight vessel lots: MA02, W3, CC02, HCC4, CN07, CN10, P1, and MO8. The residues encountered on the sherds from Vessel Lots CN07 and CN10 were observed on the exterior surfaces of the vessel. Although these residues could be related to the vessel's function (e.g., splattering), their location on the exterior surfaces made them less reliable indicators of vessel function. Likewise, the residues encountered on sherds from Vessel Lot MA02 were found on spalled surfaces and along a break, and thus considered unreliable as indicators for use of the vessel. The residue on Vessel Lot P1 appeared related to the use of the pot, however there did not appear to be enough to provide an adequate residue sample. The residue adhered to Vessel Lot W3 was removed and submitted for AMS dating, which required all of the residue and did not leave a sample for botanical assessment. Charred material was also identified on Vessel Lot HCC4 and was submitted for AMS dating, but did not appear to be suitable for further analysis.

**Residue Analysis**

Vessel Lots CC02 and MO8 contained the most residue on their sherds. Residue was scraped for both AMS dating and submitted for botanical analysis. The sherds were examined to determine the nature and potential for identification of the charred residue. The goals of this analysis were to determine, if possible, the nature of the residue, plant or animal, and identify the potential for further identification.

***Methodology***

At no time during the analysis was any portion of the sherds or residue altered or handled. Each sherd was examined under incident light microscopy with a magnification of 20-120x. Significant features of the ceramic surfaces, both interior and exterior, were noted. The charred fragments adhered to the interior surface were examined under a variety of magnifications. The visible charred fragments were then examined for any visible botanical anatomy, and categorized in terms of plant cell types, whether parenchyma (storage cells), sclerenchyma (fibers) or vascular tissues (xylem and phloem).

***Results***

*Sherd 4268-1, Lot CC02-Surface Features*. Much of the interior surface of this sherd was impressed with what appears to be cords, made presumably from vegetable fiber. No 'weft' was visible under microscopic examination, which meant that this might not be a textile impression, but rather the impression of coiled string or thin rope (Hurley 1979). The state of preservation was not good enough to provide an identification of fiber type or a clear indication of spin direction.

The surface of the fragment contained several gaps that may represent the use of plant material as temper in the production of the ceramic. While the form of many of these impressions in the surface was suggestive of plant tissues, the poor preservation of the surface precluded identification of the nature of this evidence.

*The Residue*. Four areas on the interior of the sherd contained charred material. All four areas were small and measured less than 1 mm in greatest dimension. In one case, the fragment consisted of organic material reduced to solid amorphous carbon. The three other fragments showed clear evidence for plant tissue cells, consisting primarily of vascular tissue and associated fibers. These vascular tissues appeared to be secondary in origin, which meant it was ‘woody’ tissue. This type of tissue is found in a variety of plant organs including stems both from small shrubs and perennial plants, as well as trees, and in the vegetative storage organs of many taxa. Some common vegetables that bear this kind of anatomical feature include the carrot, the beet, the radish, and the parsnip. Many economically useful species native to North America also show this kind of anatomy. In the largest of the fragments, parenchyma cells (storage cells) were present in association with the vascular tissues and fibers. These cells suggested that the plant tissues originated from a vegetative storage organ.

*Sherd 1207-1, Lot MO8-Surface Features*. No cord impressions were visible on the surfaces of this sherd. However, evidence for vegetable matter used as temper was present and in a better state of preservation than in sherd 4268-1. One area on the interior of the sherd appeared to be an impression of a seed of a grass or sedge (Poaceae/Cyperaceae). As with the previous sherd, this evidence reflected the manufacture of the ceramic rather than its use.

*The Residue*. The charred fragments of plant residue were more abundant on this sherd. Seven fragments were found on the interior of the sherd, and an additional five were present in the sample of residue removed from the sherd. All of the fragments were composed of secondary vascular tissue, with some showing evidence for parenchyma cells (storage cells) as well. These residue fragments suggested that the plant tissues originated from a vegetative storage organ.

The analysis of the charred residue on the interior surface of ceramic sherds 1207-1 and 4268-1 confirmed the presence of plant tissues. These tissues were firmly associated with the function of the vessel and therefore likely indicated economic use. The consistent association of secondary vascular tissues and storage cells (parenchyma) suggested that these represented secondary roots. Many plants with such storage organs could have been used as food plants by Native groups in eastern North America. As is the case with many of these organs, cooking was required to break down the secondary tissues and reduce the toughness and palatability of this resource.

The identification of these remains to a more precise taxonomic level would require the use of Scanning Electron Microscopy (Hather 1993). Unfortunately, these fragments were not of sufficient size to warrant such an investigation. In most cases, the identification of secondary roots depends upon the relative breadth of various tissue types within the organ (Hather 1993; Perry 1997), which requires a more complete charred fragment. In the case of primary roots, such as cattail (*Typha*) rhizomes, very small fragments such as these can be identified (Perry 1997, 1999).

The lack of identifiable residues on the sherds of the assemblage should not be viewed as a negative indicator of vessel use. The lack of organic residues has much to do with preservation of these residues over time. The site evidenced a lack of large pieces of charcoal, even within TAS features, which would be more likely to preserve over time. Therefore, adherent residues would not be expected as common for the site, even if vessels were primarily being used in the preparation of food. At this site, the residues proved more useful as chronological indicators by directly dating the sherds where they were adhered, than they did as signs of vessel function. However, the mere presence of any residue was important and illustrated that such information could be present even at a site with a general lack of organic preservation.

### Vessel Function Summary

Careful examination, comparison and contrast of these different ceramic attributes: form, including shape and thickness; temper, by type, amount, and resulting porosity; and use wear, including discoloration, alterations, and presence of residues are important for making determinations of vessel use. In general, the attributes considered most efficient for cooking vessels include thin walls, rounded bases, moderate amount of temper which expands similarly as the clay, and increases in number and size of pores within the paste, are all related to increased resistance to the thermal stresses associated with cooking. Vessels utilized mainly for storage or transport would tend to have attributes more suited to reducing mechanical and sudden stresses, such as stacking or dropping. These characteristics include thicker walls, coarse and larger temper material, fewer and smaller pores, and increased fabric hardness. Vessel use may change through time and social or symbolic factors may influence vessel manufacture and result in vessels containing attributes not ideally suited for their intended use.

Based on the defined ceramic attributes, function was estimated for 14 of 26 vessel lots (Table 14.2). Often attributes were contradictory or indicated other types of influences. Form and the presence of residue seemed to be the best indicators of function. Average body thickness generally decreased through time although ceramic types did cluster with similar thickness. Temper type and processing, while possible indicators of vessel function, may also reflect cultural choice in temper and processing as well as differential mobility and access to resources (i.e., steatite). Use wear indicated by heating evidence was problematic and may reflect either initial firing of the vessels or subsequent use. Eight vessels were assumed to represent cooking vessels based on form and the presence of residue; six vessels (all Marcey Creek) suggested storage or transport vessels because of the form and lack of residue.

## MANUFACTURING LOCATIONS AND MOBILITY

Ceramic attributes may be examined to establish where vessels are manufactured and to answer questions that relate to group mobility, trade networks, or cultural exchange of influences. Ceramics are constructed with two main substances: clay and temper. The sources for each of these may be similar or come from very different areas. The source of temper is often more easily established than that for clay. For example, steatite tempered ceramics found at coastal plain sites located hundreds of miles from known steatite sources. After the general source area is established, more sophisticated mineralogical examination of the temper could be made and compared to current provenance studies that seek to determine and characterize quarry sites and mineral sources.

## Table 14.2 Vessel Function Attributes and Possible Function

| Vessel Lot | Form | Average Body Thickness | Volume | Temper Type | Temper Processing | Use Wear (Heating Evidence) | Residue | Possible Function |
|---|---|---|---|---|---|---|---|---|
| **MA01** | Flat bottom | 10.2 mm | n/a | Schist/steatite | > variation | Interior Base | n/a | Undetermined |
| **MA02** | Prob. Conoidal | 8.1 mm | n/a | Schist/clay | > variation | Exterior Body | Yes | Cooking |
| **MA03** | Flat bottom | 9.4 mm | n/a | Schist/steatite | > variation | n/a | n/a | Storage/Transport |
| **MA04** | Flat bottom | 9.3 mm | n/a | Schist/steatite | > variation | n/a | n/a | Storage/Transport |
| **MA05** | Flat bottom | 12.9 mm | n/a | Schist/steatite | > variation | n/a | n/a | Storage/Transport |
| **MA06** | Flat bottom | 9.5 mm | n/a | Schist/steatite | > variation | Interior | n/a | Undetermined |
| **MA07** | Flat bottom | 11.2 mm | n/a | Schist/steatite | > variation | n/a | n/a | Storage/Transport |
| **MA09** | Flat bottom | 9.8 mm | n/a | Schist/steatite | > variation | n/a | n/a | Storage/Transport |
| **MA11** | Flat bottom | 10.7 mm | n/a | Schist/steatite | > variation | Interior Body and Base | n/a | Undetermined |
| **MA12** | Flat bottom | 9.3 mm | n/a | Schist/steatite | > variation | n/a | n/a | Storage/Transport |
| **W3** | Conoidal | 9.1 mm | n/a | Quartz | > variation | n/a | Yes | Cooking |
| **W4** | n/a | 7.8 mm | n/a | Quartz | n/a | Interior Rim | n/a | Undetermined |
| **CC02** | n/a | 9.0 mm | n/a | Clay | n/a | n/a | Plant | Cooking |
| **CC06** | n/a | 8.5 mm | n/a | Clay/grog | n/a | Interior Rim | n/a | Undetermined |
| **CC12** | n/a | 6.8 mm | n/a | Clay (minimal) | n/a | Yes | n/a | Undetermined |
| **HCC4** | Conoidal | 9.0 mm | 3.1 gallons | Clay/sand | < variation | Red Base; Dark Rim | Yes | Cooking |
| **CN01** | n/a | 9.1mm | n/a | Clay | n/a | Interior and Exterior Body | n/a | Undetermined |
| **CN02** | n/a | 13.2 mm | n/a | Clay | n/a | Red Base; Dark Rim | n/a | Undetermined |
| **CN07** | n/a | 10.8 mm | n/a | Clay/sand grit | n/a | Interior | Exterior | Cooking |
| **CN10** | Conoidal | 10.5 mm | n/a | Clay/sand grit | < variation | Interior and Exterior Rim | Exterior | Cooking |
| **CN20** | n/a | 10.0 mm | n/a | Quartz/sand/clay | n/a | Exterior | n/a | Undetermined |
| **HCN1** | n/a | 10.0 mm | n/a | Clay (minimal) | n/a | Interior | n/a | Undetermined |
| **HCN2** | Conoidal | 10.0 mm | 2.9 gallons | Clay | < variation | Interior and Exterior Rim | n/a | Undetermined |
| **P1** | n/a | 8.1 mm | n/a | Quartz/sand | n/a | n/a | Yes | Cooking |
| **MO8** | n/a | 9.0 mm | n/a | Shell | n/a | Interior | Plant | Cooking |
| **H4** | n/a | n/a | n/a | Quartz/and grit | n/a | Red Exterior; Dark Interior | n/a | Undetermined |

Using petrographical analyses first to establish potential temper sources allows for a more focused search for potential clay sources. For example, if the temper type is considered to be local to where the ceramic is found, then trying to establish a local clay source first would be advantageous and have implications for mobility questions. Furthermore, if temper sources are extra-local or exotic, then the potential for divergent clay sources also exists and has a different set of implications that may include trade or social migration.

Determining the source of clay used to manufacture ceramics is more difficult and requires different approaches. At first, vessels may be examined visually and macroscopically to characterize the type and range of natural inclusions within the paste. Again, this broad approach may allow for determinations about local and non-local sources. If natural inclusions within the clay source are not considered a part of the local sedimentology, then the clay source is not local. A variety of more detailed studies can be conducted on ceramics and include thin-section analysis, x-ray diffraction spectroscopy, x-ray fluorescence spectroscopy, and newer techniques of plasma emissions spectroscopy (Orton et al. 1993). These different techniques each have their own strengths and weaknesses, and are often influenced by the nature of the clay and the firing process. The most common of these analyses and increasingly becoming a standard part of ceramic analysis in general, is thin-sectioning. Thin-sections allow for a detailed description of the type, range, size, and density of natural inclusions within the clay source. These results can be compared to attributes of other ceramics within the collection to identify vessel lots manufactured from similar clay sources. Next, they could be compared to other collections (if available) to see patterns, either locally or regionally. Samples of local clays could also be collected, fired, and thin-sectioned to provide a comparative control from a known source. More of this type of analysis will increase the size of the comparative database and understanding of ceramic manufacture and distribution.

In addition to identifying temper and clay sources, regional comparisons of type distributions can also be utilized (Orton et al. 1993). This is accomplished with a standard distribution model with a central point that represents the manufacturing location area, with concentrations decreasing as distance away from the center increases. However, such a model is overly idealized and does not take into consideration many variables such as natural topography, which may facilitate or impede distribution, or more complicated cultural exchange systems. In addition, this type of analysis would require a large, regional database for comparison of types, concentrations, and locations. Despite these limitations, examining regional distributions for trends in the concentration of a specific ceramic type at a site and/or the increased frequency of sites with a specific type, can aid in understanding the range of distribution of a type, if not its exact point of manufacture.

In order to answer questions related to group mobility, trade, and stylistic influence, a regional perspective is required. Ceramic manufacturing techniques developed over time and distance. The trends that are observed at a specific site lack meaning and focus without an examination of the wider regional context within which the site occurs. With an understanding of the function, chronological context, and manufacturing attributes of ceramics, cluster analyses can be undertaken to determine patterns within and between sites for a fuller understanding of traditional ceramic ware-types, and an assessment of their validity.

## Thin Section Analysis

### *Introduction*

Thin section analysis of ceramics has become a more common practice performed during the analysis of ceramic assemblages. Such analysis can provide more detailed information about manufacturing techniques, clay-sources, temper materials, and inclusions than is attainable through typical ceramic analysis. At Hickory Bluff, a sample of ceramics was selected for thin section analysis to more fully characterize the range of inclusions within and between the major ceramic types, the nature of the clays being utilized, and the variety of the temper materials. In addition, archaeologically recovered ceramics were compared to experimental clay tiles for comparison and contrast of the clay characteristics.

### *Methodology*

A sample of 33 ceramic sherds recovered from the Hickory Bluff site were thin-sectioned and subjected to petrographic analysis. The samples were selected to represent each of the different ware types encountered at the site (Table 14.3), and to provide a larger, detailed comparison of the most dominant ware-types from the site (i.e., Marcey Creek and Clay Tempered wares).

In addition, four "experimental" clay tiles and one sedimentary concretion were also submitted for thin-section analysis for comparative purposes. Clay for one test tile was collected at the site, while the other three were from sources approximately 12 miles north of the site (Figure 14.2). No tempering agents were added to the clay used for the test tiles. The clay was formed into tiles while plastic and then allowed to dry for a day prior to firing. The tiles were fired at 784° centigrade (cone 017) for three hours in a modern kiln. These samples were included to determine if the ceramics found archaeologically displayed characteristics similar to the local clays, which would suggest local manufacture. The concretion was representative of many found at the site, and was included to better characterize its components and determine if its origin was natural or possibly related to ceramic manufacturing processes.

The sherds were sectioned by Spectrum Petrographics, Inc. of Winston, Oregon. Thin-sections were stained to aid the identification of potassium feldspars, embedded in an epoxy resin, and left uncovered. Each slide was labeled with a number provided by Spectrum Petrographics, Inc. (e.g., KCN-1); these numbers are cross-referenced with the artifact catalog numbers in Table 14.4.

## Table 14.3 Thin Section Analysis by Ceramic Type

| Typology | Sample Identification | Represented Vessel Lot |
|---|---|---|
| **Marcey Creek** | 966-1 (KCN-8) | MA03 |
| | 2163-1 (KCN-15) | MA01 |
| | 2319-1 (KCN-18) | MA08 |
| | 3589-2 (KCN-23) | MA04 |
| | 3623-4 (KCN-24) | MA02 |
| | 3962-1 (KCN-26) | MA07 |
| | 4048-2 (KCN-28) | MA05 |
| | 4466-1 (KCN-32) | MA06 |
| **Dames Quarter** | 859-1 (KCN-5) | D1 |
| **Wolfe Neck** | 769-3 (KCN-4) | W2 |
| | 3780-1 (KCN-25) | W3 |
| **Popes Creek** | 1326-1 (KCN-11) | P1 |
| **Clay Tempered** | 1466-1 (KCN-13) | CC01 |
| Cord Marked | 2129-1 (KCN-14) | CC07 |
| | 2774-2 (KCN-20) | CC02 |
| | 4042-3 (KCN-27) | CC12 |
| | CX107-N (KCN-33) | HCC4 |
| | 262-1 (KCN-1) | CN02 |
| Net Impressed | 688-1 (KCN-2) | CN18 |
| | 978-1 (KCN-9) | CN08 |
| | 2255-1 (KCN-16) | CN05 |
| | 2378-3 (KCN-19) | CN10 |
| | 4277-1 (KCN-29) | CN07 |
| | 4344-1 (KCN-30) | CN06 |
| | 4415-1 (KCN-31) | CN01 |
| | CX107-FF (KCN-34) | HCN2 |
| **Mockley** | 1207-1 (KCN-10) | MO8 |
| | 2833-1 (KCN-21) | MO1 |
| **Hell Island** | 918-3 (KCN-6) | H3 |
| | 2306-1 (KCN-17) | H4 |
| **Townsend** | 740-1 (KCN-3) | T1 |
| **Minguannan** | 1413-1 (KCN-12) | MI1 |
| **Sand Tempered** | 3587-1 (KCN-22) | S1 |
| **Sedimentary Concretion** | 931-1 (KCN-7) | Natural |

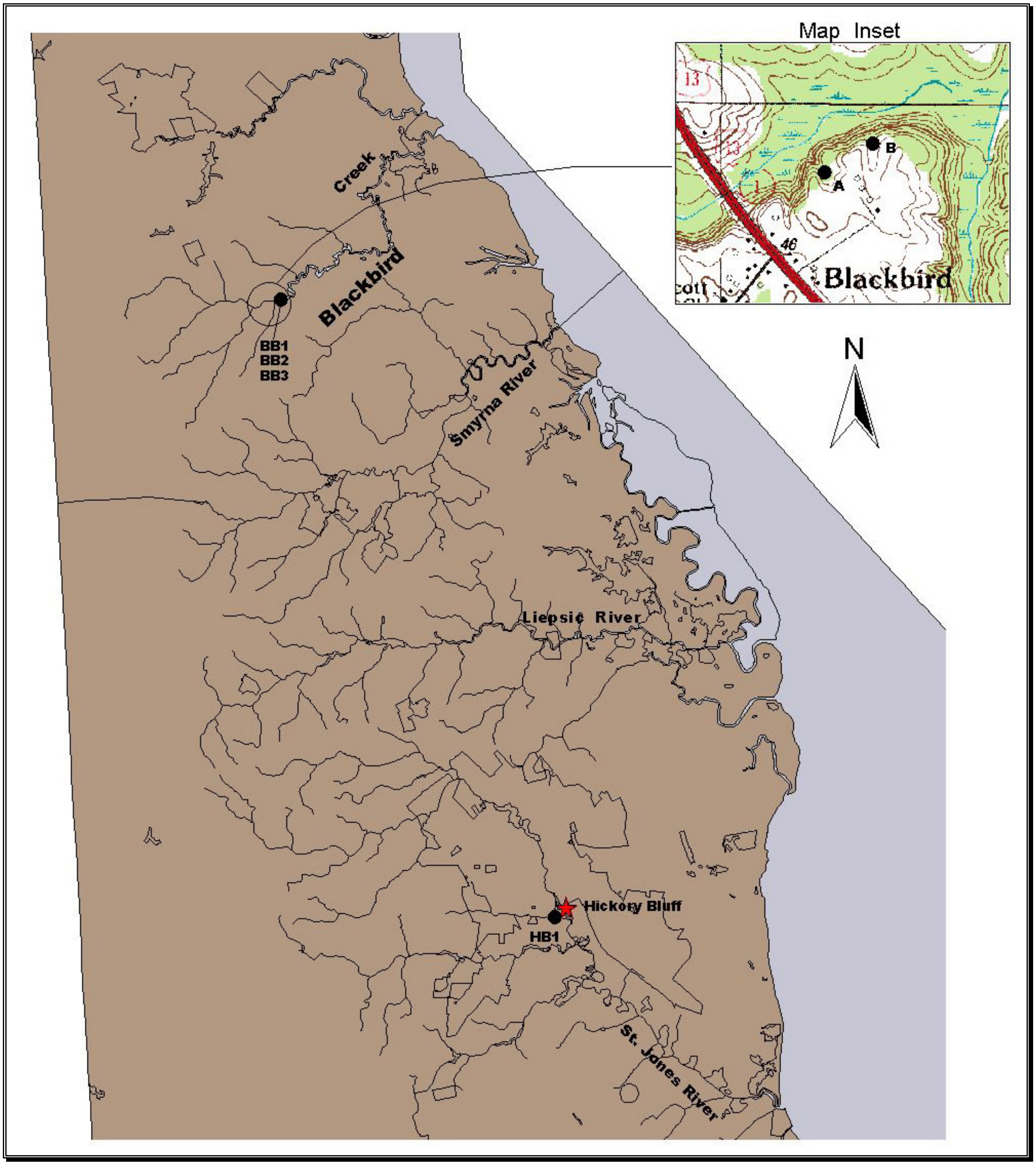


**Figure 14.2 Location of Clay Sources used for the Experimental Tiles**

## Table 14.4 Results of Thin Section Analysis

| Sample Identification (Bag-Artifact Number, Thin-section Slide Number, and Lot Designation) | Matrix Cluster | Temper type | Constituents | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % Matrix | % Temper | % Voids | % Quartz | % Feldspar | % Calcite | % Muscovite | % Opaques | % Rock-frags |
| **262-1 (KCN-1) Lot CN02** | 5 | Unfired clay | 72.30 | 5.00 | 10.60 | 1.40 | 1.40 | 0.00 | 0.70 | 8.50 | 0.00 |
| **688-1 (KCN-2) Lot CN18** | 6 | Grog | 67.40 | 7.80 | 10.60 | 7.10 | 5.70 | 0.00 | 0.00 | 1.40 | 0.00 |
| **740-1 (KCN-3) Lot T1** | 5 | None | 70.50 | 0.00 | 14.10 | 5.80 | 1.30 | 0.00 | 0.00 | 2.50 | 5.80 |
| **769-3 (KCN-4) Lot W2** | 1 | Crushed Quartz | 67.30 | 11.70 | 10.90 | 1.30 | 4.50 | 3.00 | 0.00 | 1.30 | 0.00 |
| **859-1 (KCN-5) Lot D1** | 7 | Hornblende/gneiss | 59.90 | 32.00 | 5.80 | 0.00 | 0.00 | 0.00 | 0.00 | 2.30 | 0.00 |
| **918-3 (KCN-6) Lot H3** | 3 | Crushed Quartz | 59.50 | 19.00 | 7.70 | n/a | 3.00 | 5.00 | 0.00 | 1.80 | 4.00 |
| **931-1 (KCN-7) Concretion** | - | n/a | 48.80 | 0.00 | 8.80 | 30.20 | 4.40 | 6.00 | 0.60 | 1.20 | 0.00 |
| **966-1 (KCN-8) Lot MA03** | 8 | Steatite | 51.60 | 12.00 | 10.70 | 0.60 | 6.30 | 0.00 | 14.40 | 4.40 | 0.00 |
| **978-1 (KCN-9) Lot CN08** | 9 | Grog / Sand | 76.30 | 11.50 | 9.00 | n/a | 1.90 | n/a | 0.00 | 1.30 | 0.00 |
| **1207-1 (KCN-10) Lot MO8** | 9 | Sand | 63.90 | 15.00 | 12.70 | n/a | 9.00 | n/a | 0.00 | 1.20 | 0.00 |
| **1326-1 (KCN-11) Lot P1** | 1 | Rock fragments | 53.70 | 27.50 | 12.80 | 2.40 | 0.60 | 0.60 | 0.00 | 2.40 | n/a |
| **1413-1 (KCN-12) Lot MI1** | 6 | Crushed Quartz | 79.40 | 11.00 | 4.30 | n/a | 2.10 | 1.80 | 0.00 | 1.40 | 0.00 |
| **1466-1 (KCN-13) Lot CC01** | 2 | Sand | 70.50 | 9.10 | 8.40 | n/a | 1.80 | n/a | 0.00 | 10.20 | 0.00 |
| **2129-1 (KCN-14) Lot CC07** | 3 | Grog | 59.60 | 12.00 | 13.50 | 5.60 | 1.10 | 0.00 | 0.00 | 6.70 | 1.50 |
| **2163-1 (KCN-15) Lot MA01** | 8 | Steatite | 52.70 | 22.60 | 9.60 | 0.70 | 1.40 | 0.00 | 10.30 | 2.70 | 0.00 |
| **2255-1 (KCN-16) Lot CN05** | 4 | None | 76.70 | 0.00 | 12.30 | 3.10 | 1.20 | 0.00 | 0.00 | 1.80 | 4.90 |
| **2306-1 (KCN-17) Lot H4** | 6 | Crushed Quartz | 59.70 | 17.00 | 8.20 | n/a | 6.70 | 2.40 | 6.00 | 0.00 | 0.00 |
| **2319-1 (KCN-18) Lot MA08** | 8 | Steatite | 57.00 | 23.70 | 11.00 | 0.60 | 0.60 | 0.00 | 2.60 | 4.50 | 0.00 |
| **2378-3 (KCN-19) Lot CN10** | 2 | Grog | 69.00 | 6.80 | 11.10 | 5.80 | 3.50 | 0.00 | 0.60 | 1.20 | 2.00 |
| **2774-2 (KCN-20) Lot CC02** | 4 | Sand | 66.90 | 12.80 | 7.00 | n/a | 2.50 | n/a | 0.60 | 10.20 | 0.00 |
| **2833-1 (KCN-21) Lot MO1** | 6 | Sand | 76.50 | 5.00 | 14.80 | n/a | 2.50 | n/a | 0.00 | 1.20 | 0.00 |
| **3587-1 (KCN-22) Lot S1** | 1 | Sand | 39.30 | 43.30 | 8.00 | n/a | 8.40 | n/a | 0.00 | 1.00 | 0.00 |

**Table 14.4 Results of Thin Section Analysis (Continued)**

| | | | Constituents | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Identification (Bag-Artifact Number, Thin-section Slide Number, and Lot Designation)** | **Matrix Cluster** | **Temper type** | **% Matrix** | **% Temper** | **% Voids** | **% Quartz** | **% Feldspar** | **% Calcite** | **% Muscovite** | **% Opaques** | **% Rock-frags** |
| **3589-2 (KCN-23) Lot MA04** | 6 | Steatite | 74.60 | 8.30 | 5.00 | 7.70 | 2.20 | 0.00 | 1.60 | 0.60 | 0.00 |
| **3623-4 (KCN-24) Lot MA02** | 7 | None | 79.60 | 0.00 | 4.20 | 1.60 | 0.50 | 0.00 | 5.80 | 1.00 | 7.30 |
| **3780-1 (KCN-25) Lot W3** | 6 | Crushed Quartz | 63.90 | 22.00 | 9.40 | n/a | 0.60 | 3.00 | 0.00 | 1.10 | n/a |
| **3962-1 (KCN-26) Lot MA07** | 8 | Steatite | 58.10 | 26.70 | 4.70 | 1.60 | 1.00 | 0.00 | 4.70 | 1.60 | 0.00 |
| **4042-3 (KCN-27) Lot CC12** | 4 | Shell (tentative) | 73.50 | 11.50 | 3.60 | 6.60 | 0.60 | 0.00 | 0.00 | 4.20 | 0.00 |
| **4048-2 (KCN-28) Lot MA05** | 8 | Steatite | 57.00 | 25.60 | 5.90 | 1.90 | 1.40 | 0.00 | 6.80 | 1.40 | 0.00 |
| **4277-1 (KCN-29) Lot CN07** | 4 | Shell (tentative) | 70.40 | 10.20 | 9.70 | 2.50 | 3.10 | 0.00 | 1.00 | 3.10 | 0.00 |
| **4344-1 (KCN-30) Lot CN06** | 5 | Sand/None | 72.10 | 9.30 | 11.60 | n/a | 2.90 | n/a | 0.00 | 4.10 | 0.00 |
| **4415-1 (KCN-31) Lot CN01** | 6 | Grog | 69.20 | 4.10 | 10.40 | 8.80 | 3.30 | 0.00 | 0.00 | 2.20 | 2.00 |
| **4466-1 (KCN-32) Lot MA06** | 8 | Steatite | 44.20 | 36.40 | 7.40 | 3.00 | 3.00 | 0.00 | 4.70 | 1.30 | 0.00 |
| **CX107-N (KCN-33) Lot HCC4** | 3 | Grog | 59.90 | 19.10 | 8.40 | 5.40 | 2.40 | 0.00 | 0.00 | 1.80 | 3.00 |
| **CX107-FF (KCN-34) Lot HCN2** | 3 | Unfired clay | 66.80 | 15.00 | 5.30 | 5.30 | 2.20 | 0.00 | 0.00 | 1.10 | 4.30 |
| **BB1 (KCN-35) Test Tile** | | n/a | 59.10 | n/a | 6.90 | 9.00 | 13.50 | 1.70 | 0.60 | 8.80 | 0.00 |
| **BB2 (KCN-36) Test Tile** | | n/a | 58.10 | n/a | 7.50 | 0.00 | 2.50 | 0.00 | 0.00 | 5.00 | 26.90 |
| **BB3 (KCN-37) Test Tile** | | n/a | 79.40 | n/a | 5.60 | 0.00 | 0.00 | 0.00 | 0.00 | 4.40 | 10.60 |
| **HB1 (KCN-38) Test Tile** | | n/a | 29.00 | n/a | 10.30 | 16.00 | 27.80 | 2.10 | 0.00 | 3.20 | 11.60 |

Thin-sections were examined both qualitatively and quantitatively to provide both general descriptive data for comparison of the sherds, and in an attempt to answer specific research questions:

- What is the diversity of tempering agents used in the sherds?
- Were the steatite tempered sherds produced using local clays?
- Does the temper in "Clay Tempered" sherds represent grog, fired clay, or unfired clay that was not well incorporated into the matrix?
- Does the clay in the "Clay Tempered" sherds come from the same source as the clay used for the matrix?

Qualitative analysis involved a visual scan of each sherd in plane and polarized light. Characteristics of the matrix (color, behavior under plane and polarized light, texture, iron staining) were recorded for each sherd, as were observations regarding the sorting of inclusions, size and shape of voids, and orientation of the ceramic fabric. Fabric orientation is the term used to describe when the matrix, inclusions, tempers, and voids within the paste are all lined up in parallel rows. It is observed most clearly when they line up parallel to the long axis of the sherd; it can also be noted fairly easily if the orientation is diagonal. This type of arrangement implies that while shaping the vessel, the clay was stretched primarily in one direction. This effect is most often observed in vessels that were coil-constructed, but it is not unheard of in pinched vessels. If the sherd can be oriented as it lay within the vessel, the fabric orientation might indicate the manufacturing method for the vessel.

Quantitative analysis involved point counting of the constituents of the sherd: matrix, voids, temper, and natural inclusions. The point count was accomplished using a 1x1 mm grid on small samples and a 1x2 mm grid on larger samples. The minimum number of points counted per sherd was 150.

### *Thin Section Results By Sherd*

*262-1 (KCN-1) Lot CN02.* Sample 262-1 exhibited a fine-grained matrix that included a small number (5 percent) of rounded to sub-rounded ceramic fragments (Figure 14.3). The ceramic fragments did not appear to represent "grog" in the sense of being fragments of previously manufactured vessels; rather, they appeared to be pieces of unfired clay that were not well incorporated into the overall matrix. Based on the similarity of texture, color, and inclusions of the fragments, compared to the matrix of the sample, it was likely that the fragments derived from the same clay source. The average size of the clay fragments was 1.5 mm, and individual fragments ranged from 0.5-2.0 mm in size. Natural inclusions (12 percent) within the matrix and clay fragments were poorly sorted and included quartz, feldspar, muscovite, and iron oxide. Voids (10.6 percent) consisted primarily of drying cracks oriented parallel to the long axis of the sherd. Fabric orientation was random in the sherd and in the clay fragments.

**Figure 14.3 Thin Section of Sherd 262-1 (CN02)**

*688-1 (KCN-2) Lot CN18.* Sample 688-1 exhibited a fine-grained matrix and a small amount (7.8 percent) of sub-angular ceramic fragments (grog) as temper (Figure 14.4). The grog temper was slightly finer grained and lighter in color than in Sample 4415-1, but contained a similar assemblage and density of natural inclusions, suggesting that it may have been manufactured from the same clay source. The average size of the grog temper was 1.0 mm, and individual fragments ranged from 0.4-1.5 mm in size. Natural inclusions (14.2 percent) were poorly sorted and consisted of quartz, feldspar, and iron oxide. Voids (10.6 percent) included small rounded pores and large tears. These tears occurred perpendicular to the long axis of the sherd. The fabric of the sherd was oriented at a 30° angle (northwest-southeast) from the long axis.

**Figure 14.4 Thin Section of Sherd 688-1 (CN18)**

*740-1 (KCN-3) Lot T1*. Sample 740-1 exhibited a fine-grained matrix with no added temper (Figure 14.5). Natural inclusions (15.4 percent) were poorly sorted and consisted of chert fragments, quartz, feldspar, and iron oxide. It was likely that the chert fragments acted as a natural tempering agent. Voids (14.1 percent) were primarily small rounded pores and fine cracks. Fabric orientation was random.

**Figure 14.5 Thin Section of Sherd 740-1 (T1)**

*769-3 (KCN-4) Lot W2*. Sample 769-3 exhibited a cryptocrystalline matrix with a moderate amount (11.7 percent) of crushed quartz as a tempering agent (Figure 14.6). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The average grain size of the quartz temper was 0.5 mm, while individual grains ranged from 0.1-0.75 mm in size. Individual grains were sub-angular to sub-rounded in shape and somewhat altered. Natural inclusions (10.1 percent) were poorly sorted and consisted of quartz, calcite, feldspar and iron oxide. Voids (10.9 percent) were more common and included both small, rounded pores and large linear cracks. Sherd fabric was oriented parallel to the long axis.

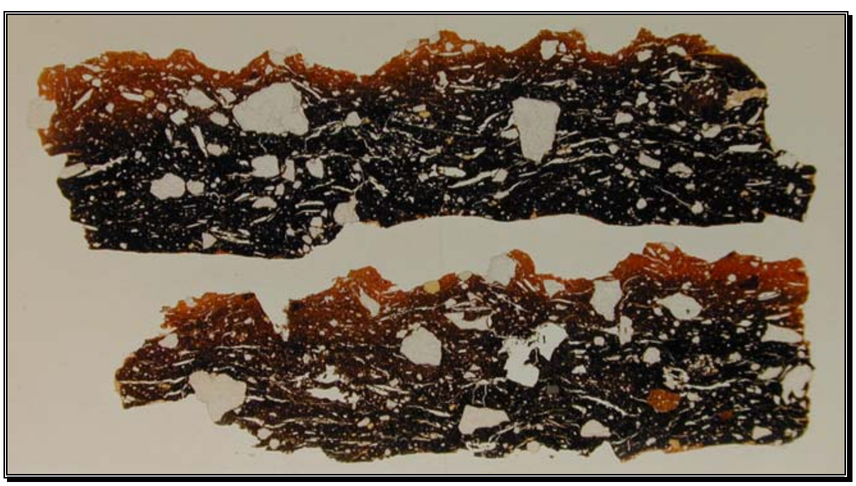

**Figure 14.6 Thin Section of Sherd 769-3 (W2)**

*859-1 (KCN-5) Lot D1. S*ample 859-1 exhibited a cryptocrystalline matrix and a high percentage of hornblende/gneiss temper (32 percent) (Figure 14.7). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The hornblende/gneiss temper included a range of grain sizes (poorly sorted), with an average grain size that measured 1.0 mm. Grain shapes included both sub-rounded and sub-angular shapes. Natural inclusions (2.3 percent) were restricted to hematite, which suggested that the clay source formed on clastic sedimentary rocks or rocks rich in mafic minerals. Voids (5.8 percent) included small rounded pores, linear cracks oriented parallel to the long axis, and cracks that encircled large hornblende/gneiss grains. Fabric orientation was random.

**Figure 14.7 Thin Section of Sherd 859-1 (D1)**

*918-3 (KCN-6) Lot H3.* Sample 918-3 exhibited a fine-grained matrix tempered with abundant (19 percent) crushed quartz (Figure 14.8). The average grain size of the quartz was 0.75 mm. The individual grains ranged from 0.1-1.0 mm in size and were sub-angular to angular in shape. Natural inclusions (13.8 percent) were poorly sorted and consisted of carbonate rock fragments, calcite, altered feldspars, and iron oxide. Voids (7.7 percent) consisted primarily of cracks oriented parallel to the long axis of the sherd, but also included voids that encircled large quartz grains. Fabric orientation was random.

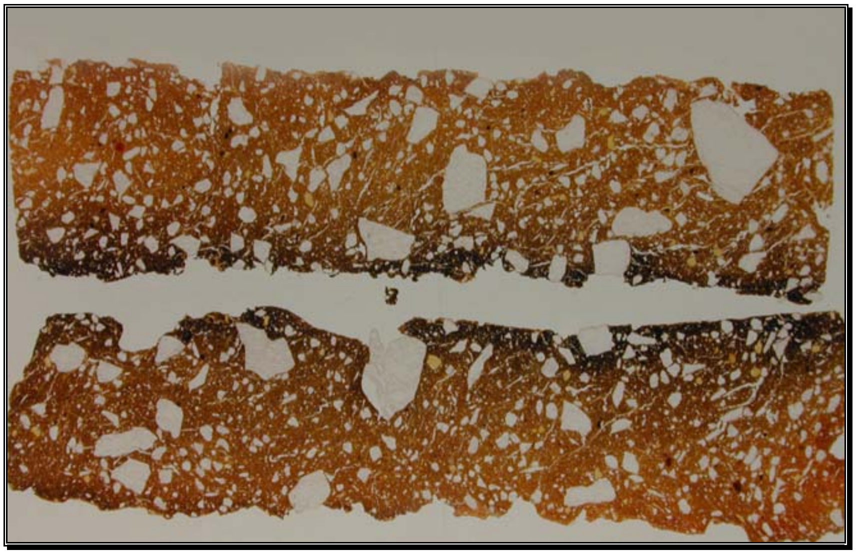

**Figure 14.8 Thin Section of Sherd 918-3 (H3).**

*931-1 (KCN-7) Concretion.* Sample 931-1 exhibited a fine-grained matrix that contained abundant natural quartz (30.2 percent), calcite (6 percent), and potassium feldspar (4.4 percent) (Figure 14.9). The average size of the inclusions was 0.25 mm, while individual grains ranged in size from 0.1-0.3 mm. Quartz and calcite grains were sub-rounded to rounded in shape, while feldspars were sub-angular to sub-rounded. Voids (8.8 percent) were irregular in shape and distribution, and rare voids exhibited secondary mineral growth. Based on its high specific gravity and cemented appearance in hand specimen, and the observation that the constituent minerals were rounded and relatively homogenous in size, the sample was interpreted as an aggregate of sand grains cemented together by iron oxide (Figure 14.10).

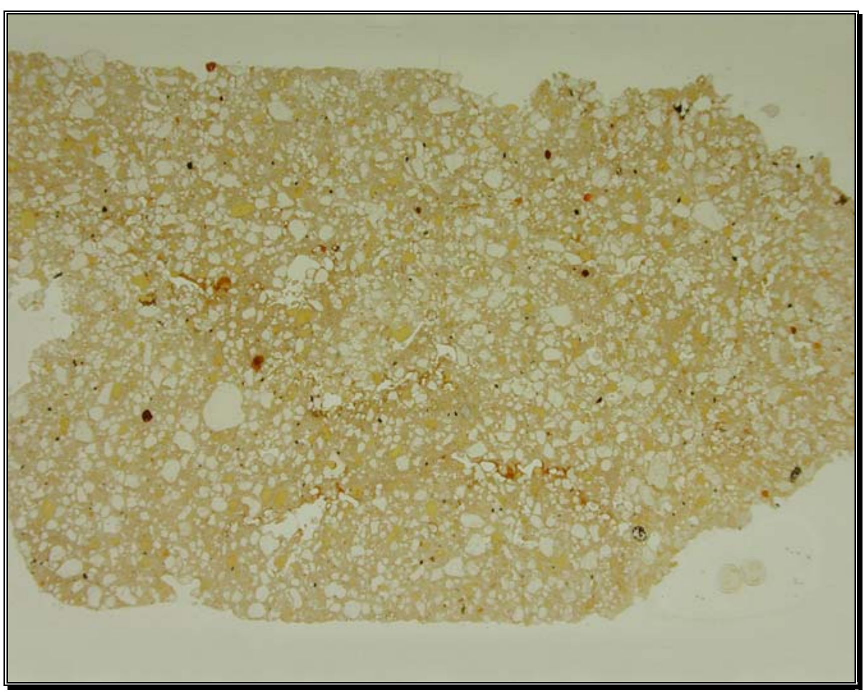

**Figure 14.9 Thin Section of Artifact 931-1 (Non Ceramic)**

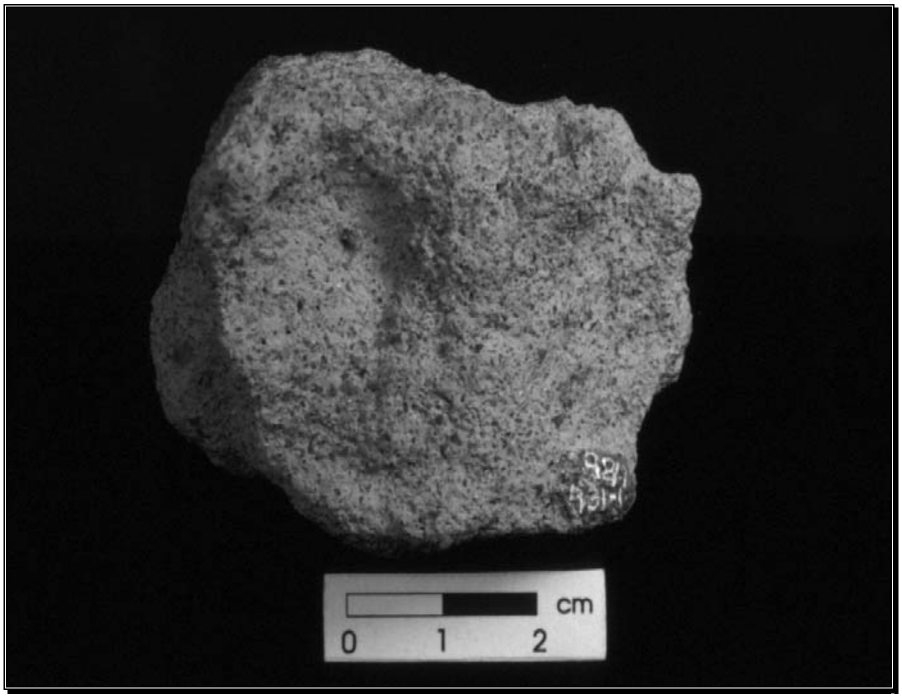


**Figure 14.10 Non Ceramic Aggregate of Sand Grains and Iron Oxide (931-1)**

*966-1 (KCN-8) Lot MA03.* Sample 966-1 exhibited a fine-grained micaceous matrix tempered with fragments of steatite (12 percent) (Figure 14.11). The average grain size of the steatite was 0.5 mm, while individual grains ranged in size from 0.25-0.6 mm. Steatite fragments were generally sub-rounded in shape. Natural inclusions (25.7 percent) were poorly sorted and consisted primarily of muscovite and feldspar, with smaller amounts of quartz and iron oxide. Voids (10.7 percent) included both small rounded pores and large tears oriented perpendicular and parallel to the long axis of the sherd. Fabric orientation was random.

**Figure 14.11 Thin Section of Sherd 966-1 (MA03)**

*978-1 (KCN-9) Lot CN08.* Sample 978-1 exhibited a cryptocrystalline matrix tempered with minor quantities (11.5 percent) of ceramic sherd fragments (grog) and sand (Figure 14.12). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The sand grains were small (<0.5 mm) and moderately well sorted, with the presence of heavily altered quartz that suggested an exposed or shallow source. The grog ranged from 0.25-2.0 mm in size; based on the identification of only five fragments within the sample; however, the average size calculations were meaningless. The matrix observed in the grog fragments was cryptocrystalline and included a small amount of quartz suggesting that the clay source of the grog was different from that used to manufacture Sample 978-1. Natural inclusions (3.2 percent) within the matrix of Sample 978-1 were restricted to potassium feldspar and iron oxide. Voids (9 percent) included small rounded pores and rare large cracks or tears. Fabric orientation was random.

**Figure 14.12 Thin Section of Sherd 978-1 (CN08)**

*1207-1 (KCN-10) Lot MO8.* Sample 1207-1 exhibited a cryptocrystalline matrix tempered with minor quantities (15 percent) of sand (Figure 14.13). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The sand grains were small (<0.5 mm) and moderately well sorted, and the presence of heavily altered quartz suggested an exposed or shallow source. Natural inclusions (10.2 percent) were poorly sorted and consisted of feldspars and hematite. Voids (12.7 percent) included the typical small rounded pores and tears, and also numerous irregular voids where minerals had been plucked or leached from the matrix. A small percentage of these latter voids had been partially filled by alteration products and/or carbonate cement. Fabric orientation was random.

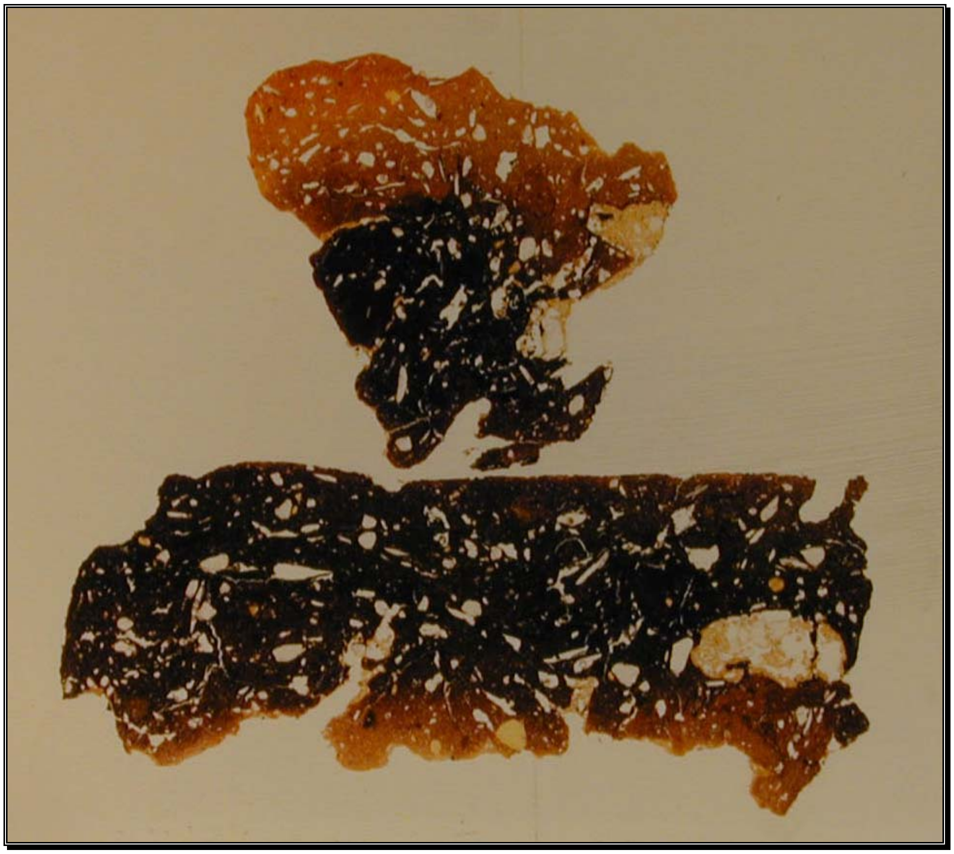

**Figure 14.13 Thin Section of Sherd 1207-1 (MO8)**

*1326-1 (KCN-11) Lot P1.* Sample 1326-1 exhibited a cryptocrystalline matrix tempered with a relatively large quantity (27.5 percent) of carbonate rock fragments (Figure 14.14). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The rock fragments were sub-angular in shape and ranged in size from 0.2-0.75 mm (average grain size was 0.5 mm). Natural inclusions (6 percent) were poorly sorted and consisted of quartz, feldspar, calcite, and iron oxide. Voids (12.8 percent) included small rounded pores and larger tears oriented parallel to the long axis of the sherd and encircled larger quartz grains. The fabric of the sherd was oriented at a 30° angle (northwest-southeast) from the long axis.

*1413-1 (KCN-12) Lot MI1*. Sample 1413-1 exhibited a fine-grained matrix tempered with a minor quantity (11 percent) of crushed quartz (Figure 14.15). The quartz grains were sub-angular in shape and ranged in size from 0.1-1.2 mm (average counted grain size was 1.0 mm, and powdered quartz grains were present as background). Natural inclusions (5.3 percent) were poorly sorted and consisted of calcite, feldspar, and iron oxide. Voids (4.3 percent) included the typical small rounded pores and tears, and also included numerous irregular voids where minerals had been plucked or leached from the matrix. A small percentage of these latter voids had been partially filled by alteration products and/or carbonate cement. Fabric orientation was random.

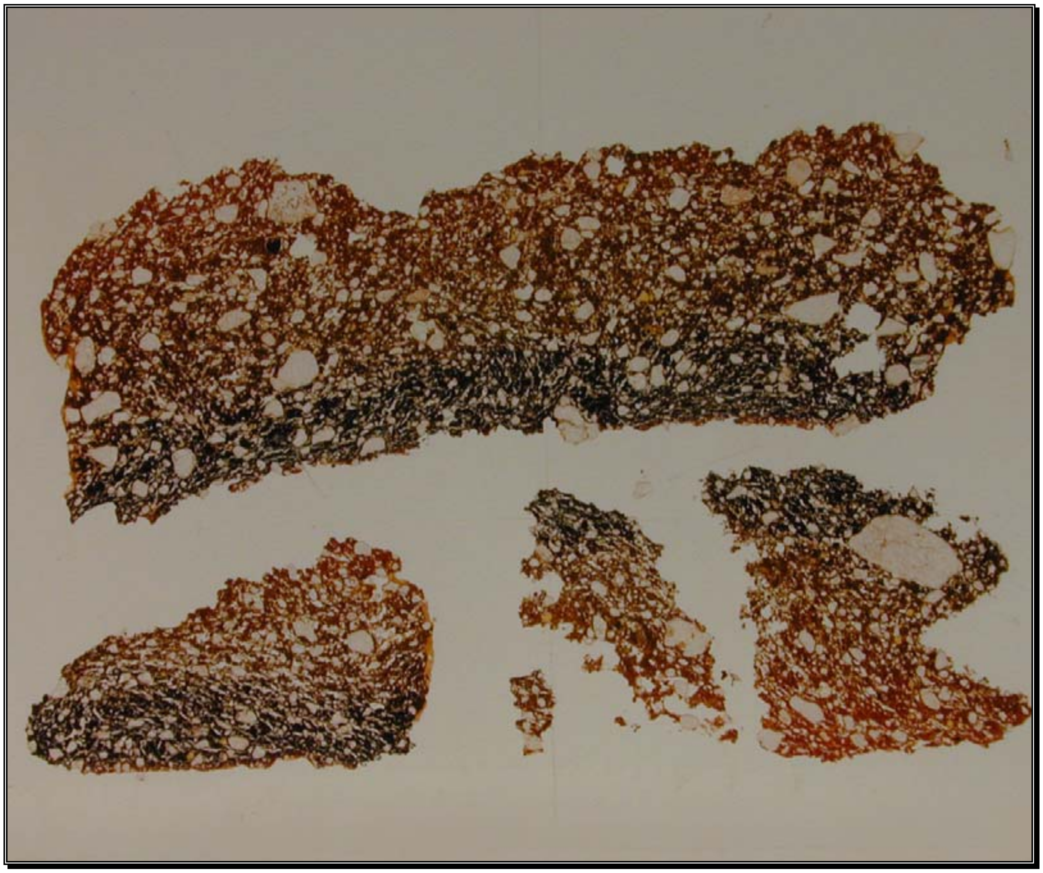

**Figure 14.14 Thin Section of Sherd 1326-1 (P1)**

**Figure 14.15 Thin Section of Sherd 1413-1 (MI1)**

*1466-1 (KCN-13) Lot CC01*. Sample 1466-1 exhibited a cryptocrystalline matrix tempered with a minor quantity (9.1 percent) of sand (Figure 14.16). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The sand grains consisted of quartz and calcite, were sub-rounded in shape, and ranged in size from 0.1-0.5 mm (average grain size was 0.25 mm). Natural inclusions (12 percent) were poorly sorted and consisted of feldspar, iron oxide, and hematite. Voids (8.4 percent) included small rounded pores and larger tears oriented parallel to the long axis of the sherd and encircled larger quartz grains. The fabric of the sherd was oriented parallel to the long axis.

**Figure 14.16 Thin Section of Sherd 1466-1 (CC01)**

*2129-1 (KCN-14) Lot CC07*. Sample 2129-1 exhibited a cryptocrystalline matrix tempered with a minor quantity (12 percent) of ceramic sherd fragments (grog) (Figure 14.17). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The grog temper was sub-rounded in shape and ranged in size from 0.5-1.2 mm (average grain size was 1.0 mm). Natural inclusions (14.9 percent) were poorly sorted and consisted of quartz, feldspar, carbonate rock fragments, and iron oxide. Voids (13.5 percent) included small rounded pores and larger tears, and numerous irregular voids where minerals had been plucked or leached from the matrix. A small percentage of these latter voids had been partially filled by alteration products and/or carbonate cement. Fabric orientation was random.

**Figure 14.17 Thin Section of Sherd 2129-1 (CC07)**

*2163-1 (KCN-15) Lot MA01.* Sample 2163-1 exhibited a fine-grained matrix tempered with steatite fragments (22.6 percent) (Figure 14.18). The average grain size of the steatite was 0.5 mm, while individual grains ranged in size from 0.25-0.6 mm. Steatite fragments were generally sub-angular to angular in shape. Natural inclusions (15.1 percent) were very poorly sorted and consisted primarily of muscovite, with smaller amounts of altered quartz, feldspar, and iron oxide. Voids (9.6 percent) included both small rounded pores and large tears oriented parallel to the long axis of the sherd. Fabric orientation was also parallel to the long axis.

*2255-1 (KCN-16) Lot CN05.* Sample 2255-1 exhibited a cryptocrystalline matrix with no added temper (Figure 14.19). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. Natural inclusions (11 percent) were poorly sorted and consisted of chert fragments, quartz, feldspar, and iron oxide; the chert fragments likely served as natural temper. Voids (12.3 percent) included small rounded pores and larger tears. Fabric orientation was generally parallel to the long axis, but spiraled around large minerals.

**Figure 14.18 Thin Section of Sherd 2163-1 (MA01)**

**Figure 14.19 Thin Section of Sherd 2255-1 (CN05)**

*2306-1 (KCN-17) Lot H4.* Sample 2306-1 exhibited a fine-grained matrix tempered with a moderate quantity of crushed quartz (17 percent) (Figure 14.20). The quartz grains were sub-angular in shape and ranged in size from 0.5-1.2 mm (average counted grain size was 0.8 mm, powdered quartz grains were also present as background). Natural inclusions (15.1 percent) were poorly sorted and consisted of calcite, muscovite and feldspar, with a small amount of iron oxide. The muscovite grains in this sample were atypical in that they appeared to be unaltered and were extremely long compared to the muscovite grains observed in other sherds. Voids (8.2 percent) included the typical small rounded pores and large tears around larger minerals. Fabric orientation was random.

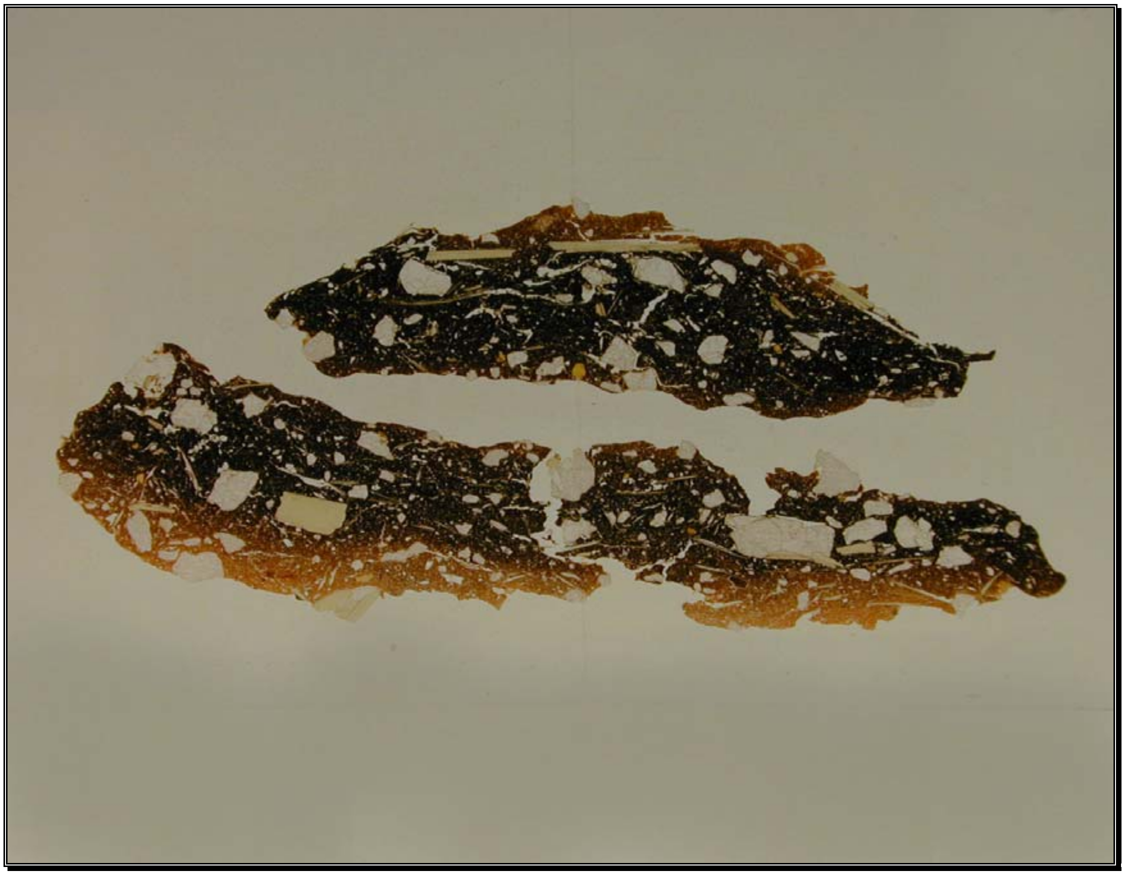

**Figure 14.20 Thin Section of Sherd 2306-1 (H4)**

*2319-1 (KCN-18) Lot MA08.* Sample 2319-1 exhibited a fine-grained matrix tempered with a high quantity of steatite fragments (23.7 percent) (Figure 14.21). The average grain size of the steatite was 0.5 mm, while individual grains ranged in size from 0.35-0.6 mm. Steatite fragments were generally sub-angular to irregular in shape. Natural inclusions (8.3 percent) were very poorly sorted and consisted of muscovite, altered quartz, altered feldspar, and iron oxide. Voids (11 percent) included both small rounded pores and large tears, and also numerous irregular voids where minerals had been plucked or leached from the matrix. A small percentage of these latter voids had been partially filled by alteration products and/or carbonate cement. Fabric orientation was random.

**Figure 14.21 Thin Section of Sherd 2319-1 (MA08)**

*2378-3 (KCN-19) Lot CN10.* Sample 2378-3 exhibited a cryptocrystalline matrix tempered with a minor quantity (6.8 percent) of ceramic sherd fragments (grog) (Figure 14.22). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The grog temper was sub-rounded in shape and ranged in size from 0.5-2.0 mm (average grain size was 1.5 mm). Natural inclusions (13.1 percent) were moderately well-sorted and consisted of muscovite, altered quartz, feldspar, carbonate rock fragments, and iron oxide. Voids (11.1 percent) included small rounded pores and larger tears, as well as irregular voids where minerals had been plucked from the matrix. Fabric orientation was generally parallel to the long axis, but spiraled around large minerals and temper.

**Figure 14.22 Thin section of Sherd 2378-3 (CN10)**

*2774-2 (KCN-20) Lot CC02.* Sample 2774-2 exhibited a cryptocrystalline matrix tempered with minor quantities of quartz sand (12.8 percent) (Figure 14.23). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The sand included quartz and calcite grains that were sub-angular to subrounded in shape, and ranged in size from 0.3-1.2 mm (average grain size was 1.0 mm). Natural inclusions (13.3 percent) were moderately well-sorted and consisted of muscovite, quartz, feldspar and iron oxide. Voids (7 percent) included small rounded pores and larger tears oriented parallel to the long axis of the sherd. Fabric orientation was generally parallel to the long axis.

**Figure 14.23 Thin Section of Sherd 2774-2 (CC02)**

*2833-1 (KCN-21) Lot MO1.* Sample 2833-1 exhibited a fine-grained matrix tempered with minor quantities of quartz sand (5 percent) (Figure 14.24). The sand included sub-rounded quartz and calcite grains that ranged in size from 0.05-0.5 mm (average grain size was 0.25 mm). Natural inclusions (3.7 percent) were moderately well-sorted and consisted of muscovite, feldspar, and iron oxide. Voids (14.8 percent) included small rounded pores and larger tears, as well as irregular voids where minerals had been plucked from the matrix. Fabric orientation was random.

**Figure 14.24 Thin Section of Sherd 2833-1 (MO1)**

*3587-1 (KCN-22) Lot S1.* Sample 3587-1 exhibited a cryptocrystalline matrix tempered with large quantities of sand (43.3 percent) (Figure 14.25). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The sand consisted primarily of sub-angular quartz and calcite grains that ranged in size from 0.3-1.0 mm (average grain size was 0.5 mm). Natural inclusions (9.4 percent) were poorly sorted and consisted primarily of muscovite and iron oxide; however, some of the smaller quartz and calcite grains noted as temper in the point count may have represented natural inclusions. Voids (8 percent) included small rounded pores and larger tears oriented parallel to the long axis of the sherd. Fabric orientation was random.

*3589-2 (KCN-23) Lot MA04.* Sample 3589-2 exhibited a fine-grained matrix tempered with minor quantities of steatite (8.3 percent) (Figure 14.26). The average grain size of the steatite was 1.5 mm, while individual grains ranged in size from 0.75-2.0 mm. Steatite fragments were generally sub-angular in shape. Natural inclusions (12.1 percent) were poorly sorted and consisted of muscovite, altered quartz, altered feldspar, and iron oxide. Voids (5 percent) included both small rounded pores and large tears. Fabric orientation was generally parallel to the long axis of the sherd.

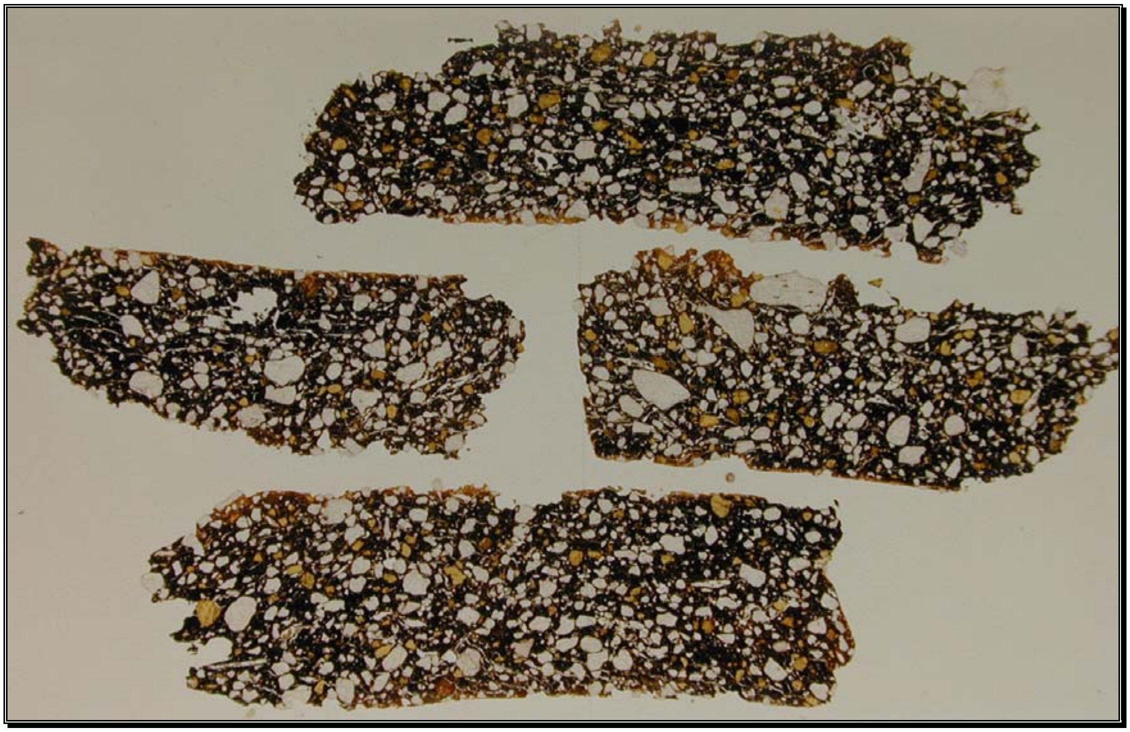

**Figure 14.25 Thin Section of Sherd 3587-1 (S1)**

**Figure 14.26 Thin Section of Sherd 3589-2 (MA04)**

*3623-4 (KCN-24) Lot MA02.* Sample 3623-4 exhibited a cryptocrystalline matrix (Figure 14.27). The matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. Natural inclusions (16.2 percent) included mafic rock fragments, muscovite, altered quartz, feldspar, and hematite. The mafic rock fragments were extremely degraded and exhibited significant alteration of mafic minerals to amorphous hematite. It was likely that the rock fragments served as natural tempering agents. Voids (4.2 percent) included small, rounded pores and long, thin cracks. Fabric orientation was parallel to the long axis of the sherd.

**Figure 14.27 Thin Section of Sherd 3623-4 (MA02)**

*3780-1 (KCN-25) Lot W3.* Sample 3780-1 exhibited a fine-grained matrix tempered with a moderate quantity of crushed quartz (22 percent) (Figure 14.28). The quartz grains were sub-angular to angular in shape and ranged in size from 0.8-2.5 mm (average grain size was 1.5 mm). Natural inclusions (4.7 percent) were poorly sorted and consisted of calcite, feldspar, and iron oxide. Voids (9.4 percent) included small rounded pores and larger tears, and also numerous irregular voids where minerals had been plucked or leached from the matrix. A small percentage of these latter voids had been partially filled by alteration products and/or carbonate cement. Fabric orientation was random.

**Figure 14.28 Thin Section of Sherd 3780-1 (W3)**

*3962-1 (KCN-26) Lot MA07*. Sample 3962-1 exhibited a fine-grained matrix tempered with a moderate quantity of steatite (26.7 percent) (Figure 14.29). The average grain size of the steatite was 2.0 mm, and individual grains ranged in size from 1.0-2.2 mm. Steatite fragments were generally sub-angular in shape. Natural inclusions (8.9 percent) were poorly sorted and consisted of muscovite, altered quartz, altered feldspar, and hematite. Voids (4.7 percent) included both small rounded pores and large tears. Fabric orientation was random.

**Figure 14.29 Thin Section of Sherd 3962-1 (MA07)**

*4042-3 (KCN-27) Lot CC12*. Sample 4042-3 exhibited a cryptocrystalline matrix that appeared to have been tempered with shell fragments (11.5 percent) (Figure 14.30). Due to leaching and soil acidity, the evidence of shell temper was restricted to curvilinear voids throughout the matrix. The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. Average length of the curvilinear voids was 4.0 mm, and leached shell fragments ranged in size from 1.5-5.0 mm. Natural inclusions (11.4 percent) were poorly sorted and consisted of weathered quartz, feldspar, and hematite. Voids (3.6 percent), apart from those left by leached shell, were restricted to small rounded pores and irregular tears. Fabric orientation was generally parallel to the long axis, but spiraled around large minerals and temper.

**Figure 14.30 Thin Section of Sherd 4042-3 (CC12)**

*4048-2 (KCN-28) Lot MA05*. Sample 4048-2 exhibited a fine-grained matrix tempered with a moderate quantity of steatite (25.6 percent) (Figure 14.31). The average grain size of the steatite was 0.25 mm, while individual grains ranged in size from 0.1-0.8 mm. Steatite fragments were generally sub-rounded in shape. Natural inclusions (11.5 percent) were very poorly sorted and consisted of muscovite, altered quartz, altered feldspar, and hematite. Voids (5.9 percent) included both small rounded pores and large tears, and also numerous irregular voids where minerals had been plucked or leached from the matrix. A small percentage of these latter voids had been partially filled by alteration products and/or carbonate cement. Fabric orientation was generally parallel to the long axis of the sherd.

**Figure 14.31 Thin Section of Sherd 4048-2 (MA05)**

*4277-1 (KCN-29) Lot CN07.* Sample 4277-1 exhibited a cryptocrystalline matrix that appeared to have been tempered with shell fragments (10.2 percent) (Figure 14.32). Due to leaching and soil acidity, the evidence of shell temper was restricted to curvilinear voids throughout the matrix. The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. Average length of the curvilinear voids was 1.0 mm, while leached shell fragments ranged in size from 0.5-2.0 mm. Natural inclusions (9.7 percent) were poorly sorted and consisted of muscovite, weathered quartz, feldspar, and hematite. Voids (9.7 percent), apart from those left by leached shell, were restricted to small, rounded pores and irregular tears. Fabric orientation was generally parallel to the long axis, but spiraled around large minerals and temper.

*4344-1 (KCN-30) Lot CN06.* Sample 4344-1 exhibited a fine-grained matrix tempered with a minor quantity of sand (9.3 percent) (Figure 14.33). The sand included sub-rounded quartz and calcite grains that ranged in size from 0.1-0.5 mm (average grain size was 0.25 mm). Natural inclusions (7 percent) were moderately well-sorted and consisted primarily of feldspar and hematite; however, it was possible that many of the quartz and calcite grains noted during the point count were natural rather than cultural inclusions, due to their small size. Voids (11.6 percent) included small rounded pores and larger tears. Fabric orientation was strongly parallel to the long axis of the sherd.

**Figure 14.32 Thin Section Sherd 4277-1 (CN07)**

**Figure 14.33 Thin Section of Sherd 4344-1 (CN06)**

*4415-1 (KCN-31) Lot CN01.* Sample 4415-1 exhibited a fine-grained matrix tempered with a minor quantity (4.1 percent) of ceramic sherd fragments (grog) (Figure 14.34). The grog temper was sub-angular to sub-rounded in shape and ranged in size from 0.75-1.0 mm (average grain size was 0.8 mm). Because the grog temper exhibited a cryptocrystalline matrix with few natural inclusions, it was likely that the grog and matrix of Sample 4415-1 derived from separate sources. Natural inclusions (16.3 percent) were moderately well-sorted and consisted of chert or carbonate rock fragments, altered quartz, feldspar, and iron oxide. Voids (10.4 percent) included small rounded pores and larger tears or drying cracks. Fabric orientation was generally parallel to the long axis, but spiraled around large minerals and temper.

**Figure 14.34 Thin Section of Sherd 4415-1 (CN01)**

*4466-1 (KCN-32) Lot MA06.* Sample 4466-1 exhibited a fine-grained matrix tempered with a large quantity of steatite (36.4 percent) (Figure 14.35). The average grain size of the steatite was 1.0 mm, while individual grains ranged in size from 0.25-1.2 mm. Steatite fragments were generally sub-rounded in shape. Natural inclusions (12 percent) were very poorly sorted and consisted of muscovite, altered quartz, altered feldspar, and hematite. Voids (7.4 percent) included both small rounded pores and large tears or drying cracks. Fabric orientation was parallel to the long axis of the sherd.

*CX107-N (KCN-33) Lot HCC4.* Sample CX107-N exhibited a cryptocrystalline matrix tempered with a moderate quantity (19.1 percent) of ceramic sherd fragments (grog) (Figure 14.36). The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The grog temper was sub-angular in shape and ranged in size from 0.5-1.5 mm (average grain size was 1.0 mm). Based on similarities in matrix texture, color, and inclusions, it was likely that the same clay source was used for the grog and for the matrix of sample CX107-N. Natural inclusions (12.6 percent) were poorly sorted and consisted of chert or carbonate rock fragments, altered quartz, feldspar, and iron oxide. Voids (8.4 percent) included small rounded pores and larger tears or drying cracks, many encircled the grog. Fabric orientation was random.

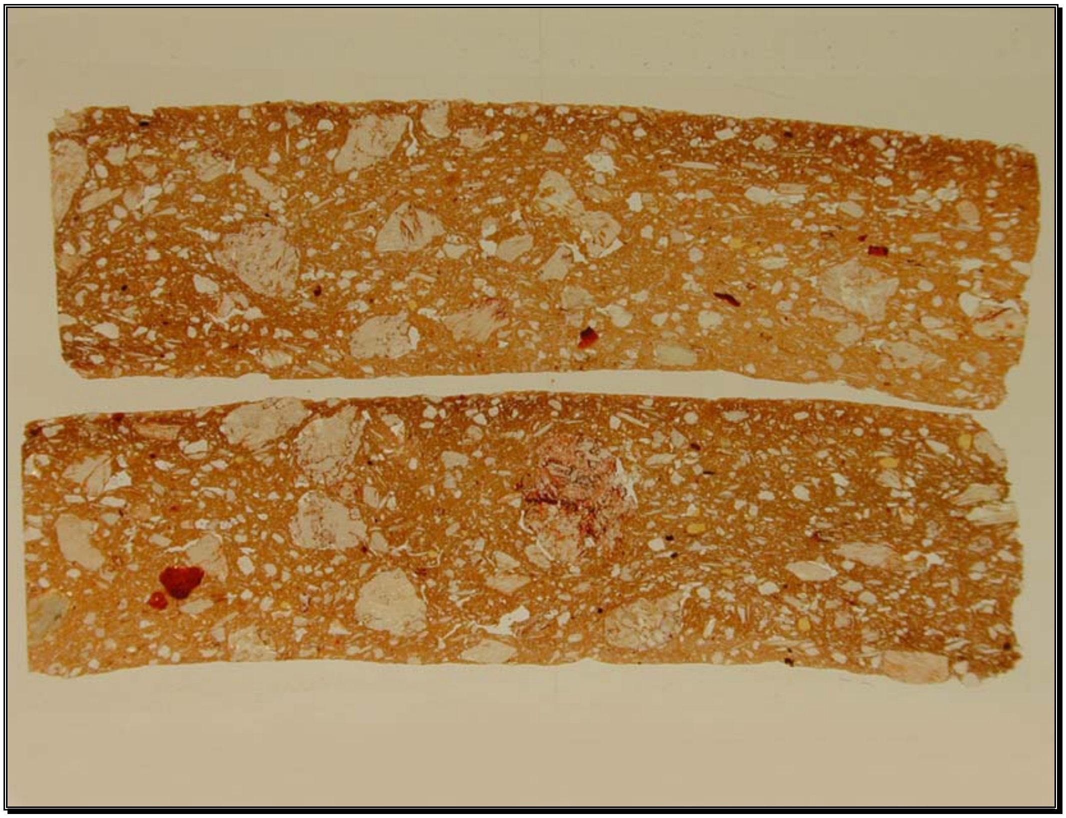

**Figure 14.35 Thin Section of Sherd 4466-1 (MA06)**

**Figure 14.36 Thin Section of Sherd CX107-N (HCC4)**

*CX107-FF (KCN-34) Lot HCN2.* Sample CX107-FF exhibited a cryptocrystalline matrix tempered with a moderate quantity (15 percent) of ceramic fragments (Figure 14.37). The ceramic fragments did not appear to represent "grog" in the sense of being fragments of previously manufactured vessels; rather, they appeared to be pieces of unfired clay that were not well incorporated into the overall matrix. Based on the similarity of texture, color, and inclusions within the fragments, compared to the matrix of Sample CX107-FF, the fragments appear to derive from the same clay source. The cryptocrystalline matrix was indicative of a higher firing temperature such that the lattices of the clay minerals in the matrix were fused and the original structure was destroyed. The fragments of clay temper were sub-rounded in shape and ranged in size from 0.6-1.2 mm (average grain size was 1.0 mm). Natural inclusions (12.9 percent) were very poorly sorted and consisted of chert or carbonate rock fragments, altered quartz, feldspar and iron oxide. Voids (5.3 percent) included small, rounded pores and larger tears or drying cracks, many encircling the clay fragments. Fabric orientation was generally parallel to the long axis of the sherd, but spiraled around large temper fragments.

**Figure 14.37 Thin Section of Sherd CX107FF (HCN2)**

*BB1 (KCN-35) Test Tile.* Sample BB1 was a test tile manufactured from clay obtained from a small tributary (labeled A) of Blackbird Creek at a depth of 3.1 m below the terrace surface (Figure 14.38). No tempering agents were added to the clay. Examination of the test tile in thin section indicated that it had a cryptocrystalline matrix (as a result of the high firing temperature) and a higher percentage (34 percent) of natural inclusions than the majority of the prehistoric ceramics examined in this study (Figure 14.39). Natural inclusions were poorly sorted and consisted primarily of altered quartz and feldspar, with smaller amounts of muscovite, calcite, and iron oxide. Voids (6.9 percent) included both small, rounded pores and irregular tears or drying cracks. Fabric orientation was random.

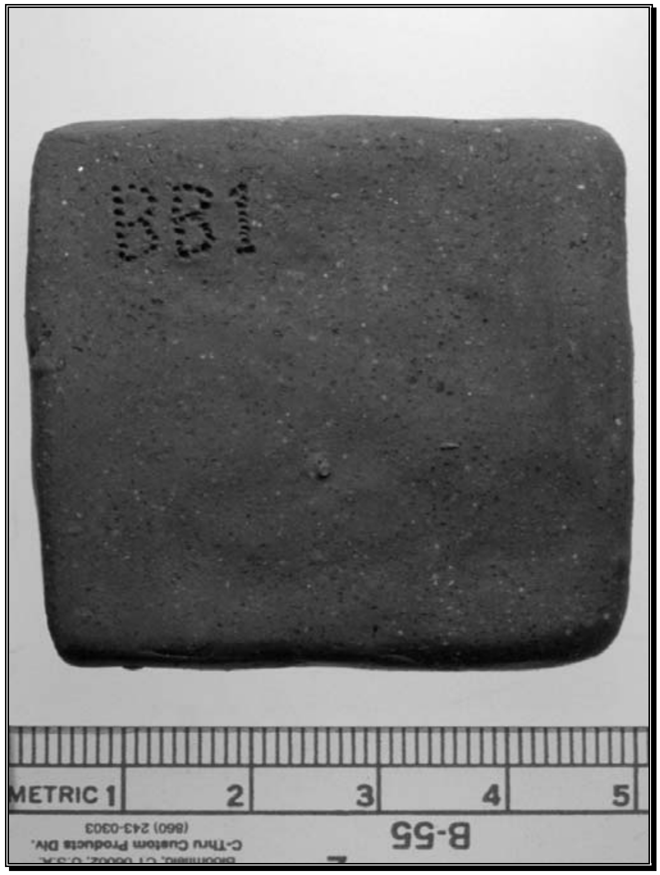


**Figure 14.38 Experimental Tile BB1**

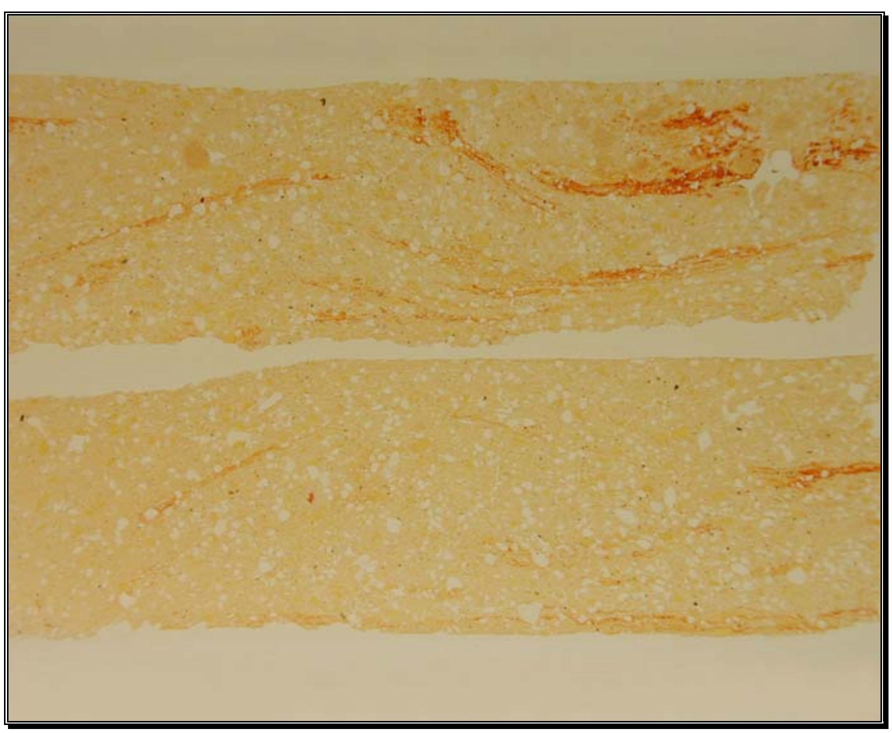

**Figure 14.39 Thin Section of Experimental Tile BB1**

*BB2 (KCN-36) Test Tile.* Sample BB2 was a test tile manufactured from clay obtained from a second small tributary (labeled B) of Blackbird Creek at a depth of 2.0 m below the terrace surface (Figure 14.40). No tempering agents were added to the clay. Examination of the test tile in thin section indicated that it had a fine-grained, micaceous matrix with a higher percentage (34.4 percent) of natural inclusions than the majority of the prehistoric ceramics examined in this study (Figure 14.41). Natural inclusions were very poorly sorted and consisted primarily of rock fragments (chert and an altered mafic rock), with smaller amounts of feldspar and iron oxide. Voids (7.5 percent) included both small rounded pores and irregular tears around the rock fragments. Fabric orientation was generally parallel to the long axis, but exhibited tight spirals or swirls around the rock fragments.

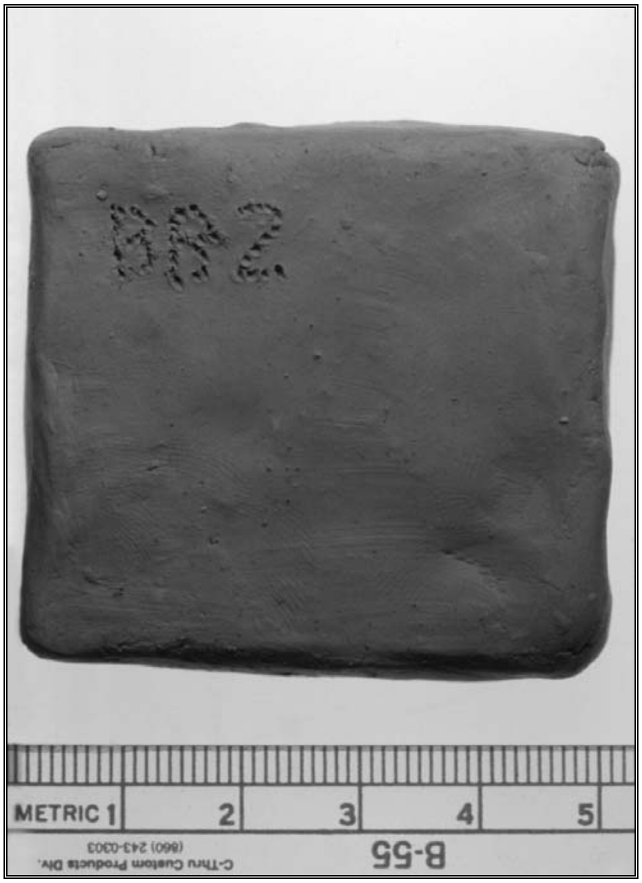


**Figure 14.40 Experimental Tile BB2**

*BB3 (KCN-37) Test Tile.* Sample BB3 was a test tile manufactured from clay obtained from a second small tributary (labeled B) of Blackbird Creek at a depth of 2.36 m below the terrace surface (Figure 14.42). No tempering agents were added to the clay. Examination of the test tile in thin section indicated that it had a fine-grained matrix that consisted in part of tiny quartz and feldspar grains (Figure 14.43). Natural inclusions (15 percent) were poorly sorted and consisted primarily of chert fragments, with a smaller quantity of iron oxide. Voids (5.6 percent) included both small, rounded pores and irregular tears or drying cracks. Fabric orientation was parallel to the long axis of the sherd.

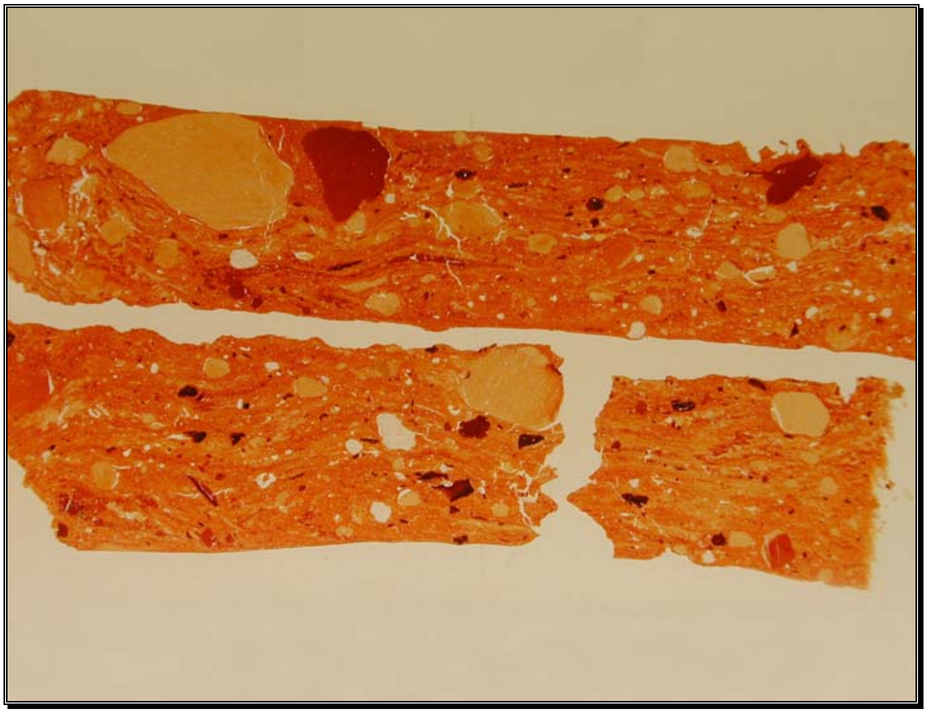

**Figure 14.41 Thin Section of Experimental Tile BB2**


**Figure 14.42 Experimental Tile BB3**

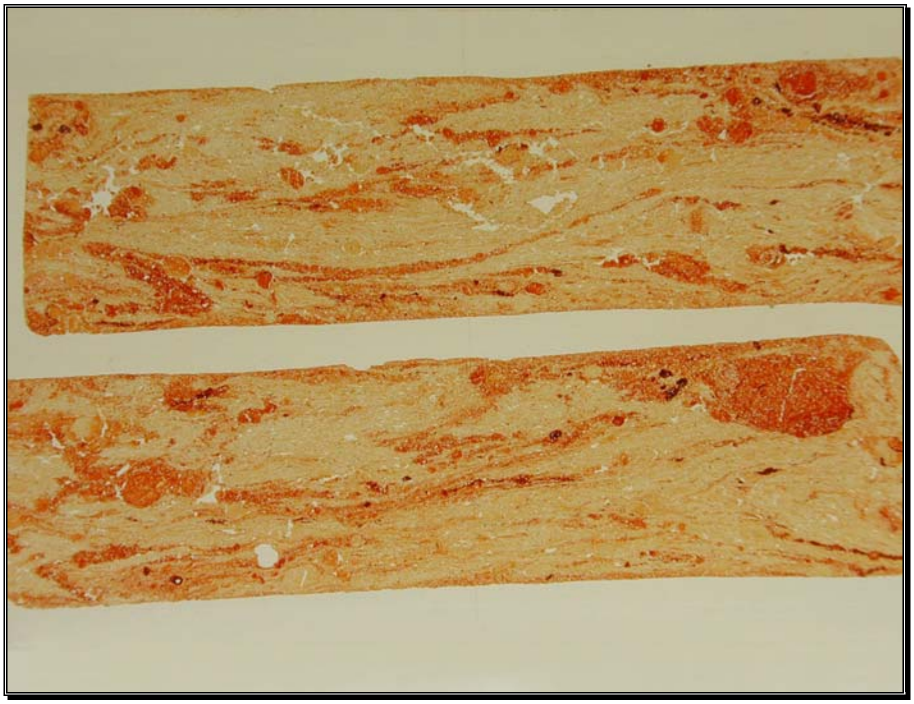

**Figure 14.43 Thin Section of Experimental Tile BB3**

*HB1 (KCN-38) Test Tile.* Sample HB1 was a test tile manufactured from clay obtained west of Hickory Bluff on the banks of Puncheon Run, south of the Puncheon Run site (7K-C-51) (Figure 14.44). No tempering agents were added to the clay. Examination of the test tile in thin section indicated that it had a cryptocrystalline matrix and the highest percentage (60.7 percent) of natural inclusions observed in the thin sections examined in this study (Figure 14.45). Natural inclusions were very poorly sorted and consisted primarily of altered quartz, feldspar, and chert fragments, with smaller amounts of calcite and iron oxide. Voids (10.3 percent) included both small rounded pores and infrequent large tears or drying cracks. Fabric orientation was random.

### *Analysis of Clay Matrix and Inclusions*

Comparison of the matrices of the 33 ceramic samples resulted in the tentative identification of nine matrix-type clusters in the data set (Table 14.5). Sample 931-1, the natural sedimentary concretion, was excluded from this portion of the study as analysis confirmed that it was a mineral aggregate and not of cultural origin. Comparison of ceramic matrices was based on texture (fine-grained versus cryptocrystalline), color in plane light, and density and type of natural inclusions. Tempering agents were not included in this comparison, apart from the recognition that prehistoric potters would likely have used tempering agents with consistent firing properties for a given clay type and set of firing conditions (i.e., grog and steatite fragments may have been interchangeable in terms of size, angularity, etc., while sand and steatite would not have been interchangeable). Matrix Clusters 1, 4, 7, and 8 were the strongest, while Matrix Clusters 3 and 6 were the weakest.


**Figure 14.44 Experimental Tile HB1**

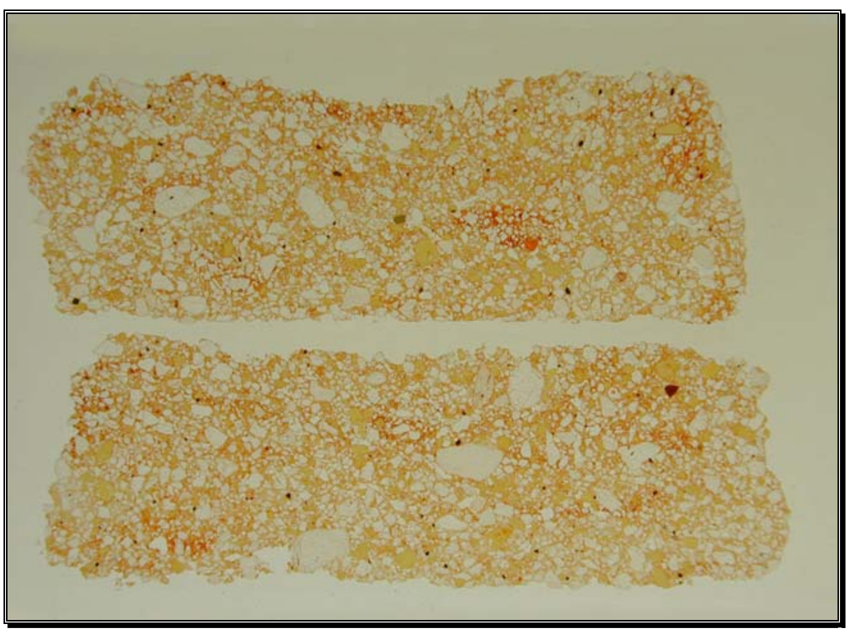

**Figure 14.45 Thin Section of Experimental Tile HB1**

## Table 14.5 Comparison of Ceramic Matrices

| Matrix Cluster | Cluster Members/ Represented Lots | Color | Texture | Natural Inclusions | Similarity to Other Clusters | Similarity to Test Tiles |
|---|---|---|---|---|---|---|
| **1** | 769-3/W2, 1326-1/P1, 3587-1/S1 | Black | Cryptocrystalline | Low density of inclusions (6-10.1 percent); poorly sorted; includes feldspars, calcite, quartz, and iron oxides | | HB1 (most similar to 3587-1) |
| **2** | 1466-1/CC01, 2378-3/CN10 | Brown to black | Cryptocrystalline | Moderate density of inclusions (12-13.1 percent); poorly to moderately well sorted; slightly micaceous matrix; includes quartz, feldspars, and iron oxides. | Cluster 3 | |
| **3** | 918-3/H3, 2129-1/CC07, CX107-N/HCC4, CX107-FF/HCN2 | Brown to black | Fine-grained | Moderate density of inclusions (12.6-14.9 percent); poorly sorted; slightly micaceous matrix; includes feldspars, iron oxide, and carbonate rock fragments. | Cluster 2 | |
| **4** | 2255-1/CN05, 2774-2/CC02, 4042-3/CC12, 4277-1/CN07 | Reddish black | Cryptocrystalline ; Fabric has spirals/ swirls | Low density of inclusions (9.7-11.4 percent); poorly sorted; slightly micaceous matrix; includes quartz, feldspar, and iron oxides. | | BB2 (most similar to 2255-1) |
| **5** | 262-1/CN02, 740-1/T1, 4344-1/CN06 | Cloudy, light brown | Fine-grained | Low to moderate density of inclusions (7.0-15.4 percent); poorly sorted; includes quartz, feldspar, and iron oxide | Cluster 6 | BB1 (but samples are much more weathered than clay source) |
| **6** | 688-1/CN18, 1413-1/MI1, 2306-1/H4, 2833-1/MO1, 3589-2/MA04, 3780-1/W3, 4415-1/CN01 | Light brown | Fine-grained | Low to moderate density of inclusions (3.7-16.2 percent); poorly sorted; slightly micaceous matrix; includes quartz, feldspar, calcite, and iron oxide. | Cluster 5 | |
| **7** | 859-1/D1, 3623-4/MA02 | Red to reddish brown | Cryptocrystalline | Low to moderate density of inclusions (2.3-16.1 percent); poorly sorted; low density of voids; includes hematite (both sherds) – 3623-4 also includes quartz, feldspar, and muscovite. | | BB3 (most similar to 3623-4) |
| **8** | 966-1/MA03, 2163-1/MA01, 2319-1/MA08, 3962-1/MA07, 4048-2/MA05, 4466-1/MA06 | Reddish brown | Fine-grained | Moderate to high density of inclusions (8.3-25.7 percent); very poorly sorted; extremely micaceous matrix; includes quartz, feldspar, abundant muscovite, and iron oxide. | | |
| **9** | 978-1/CN08, 1207-1/na | Reddish brown to black | Cryptocrystalline | Low density of inclusions (3.2-10.2 percent); poorly sorted; includes feldspar and iron oxide. | | |

Firing conditions such as temperature, duration, fuel type, and amount of oxygen present can affect the appearance and texture of the clay matrix in a ceramic vessel. Consequently, it was difficult to ascertain whether slight differences in color and texture between matrix-type clusters related to different clay sources or different firing conditions. It, therefore, was possible that two or more of the identified matrix-type clusters derived from the same clay source. Matrix-type clusters that were similar, except for slight differences in texture and/or color, are indicated below, and potentially collapse the number of source areas to seven.

Finally, matrix-type clusters were compared to the matrices observed in the four experimental tiles, in attempt to correlate one or more clusters with an identified clay source. The correlation of Matrix Cluster 4 with the clay source represented by BB2 is considered to be fairly strong, based on the apparently diagnostic swirls and spirals in the paste. The correlation of Matrix Clusters 1, 5, and 7 with the clay sources represented by HB1, BB1, and BB3, respectively, are more tentative. They were based more on a similarity of a specific sample within the cluster to the test tile, than on a similarity with all samples in the cluster.

Matrix Cluster 4, which most strongly correlated with a local clay tile (BB2), consisted entirely of Clay Tempered ceramics, both cord and net impressed. This correlation suggested that these Clay Tempered vessels could be produced in the site vicinity, as their natural inclusions, temper material, and matrix are consistent with the clay found locally.

Conversely, all but two of the Marcey Creek sherds submitted for thin section clustered into Matrix Cluster 8. This cluster did not show similarity to any of the experimental clay tiles. This conclusion and the fact that known steatite quarries are located hundreds of miles from the site, suggested that these vessels were manufactured elsewhere. Marcey Creek sherd 3623-4, which was not part of Matrix Cluster 8, was the only Marcey Creek sherd to show similarity to an experimental clay tile, BB3. Interestingly, this sherd was part of ceramic Vessel Lot MA02, which was classified as an atypical Marcey Creek vessel. It was likely conoidal in form and narrow coil constructed, traits more typical of Selden Island ware. Unlike Selden Island ware, however, the exterior surface was smooth, not cord-marked. Matrix Cluster 7 also included the Dames Quarter sherd submitted for analysis. This was significant as Dames Quarter is thought to represent more localized experimentation with manufacturing attributes established with Marcey Creek ceramics.

Matrix Cluster 1, which was tentatively considered similar to local clay sample HB1 was also interesting. This cluster contained examples from Vessel Lots W2, P1, and S1. Vessel Lot W2 represented Wolfe Neck ware, a crushed quartz tempered vessel type common on the Delmarva Peninsula. Vessel Lot P1 represented Popes Creek ware, which is more commonly encountered further west in and around the Chesapeake Bay region. The recovery of a Popes Creek vessel lot as far east as Hickory Bluff was considered atypical. The fact that it correlated loosely with a local clay source was therefore significant. Popes Creek ware is characterized by sand temper, and Vessel Lot S1 in the matrix cluster was a sand tempered vessel that was not able to be included within a traditional type definition. The local clay sample closely correlated to the sherd from this vessel lot. This result suggested that Vessel Lot S1 could represent localized variation of more traditional Popes Creek technology.

Matrix Cluster 5 was considered similar to a locally procured experimental clay tile, BB1. This matrix cluster consisted of samples from Clay Tempered Vessel Lots CN02 and

CN06 and Townsend Vessel Lot T1. The correlation of the local source with Clay Tempered vessels was also observed in Matrix Cluster 4 and, given the high frequency of Clay Tempered ceramics at Hickory Bluff, would seem to follow. However, the correlation of Vessel Lot T1 to a local source was interesting given the overall low frequency of all Late Woodland type ceramics at the site. It loosely suggested that despite less intensity of site use similar raw material sources, in this case clay, were continuing to be used into the Late Woodland.

The “weaker” Matrix Clusters 3 and 6 also provided notable information. Matrix Cluster 3 contained samples that represented Clay Tempered Vessel Lots CC07, HCC4, and HCN2 and Hell Island Vessel Lot H3. This cluster was considered not strongly correlated and showed no similarity to a local clay tile. This result was somewhat curious given the inclusion of Vessel Lots HCC4 and HCN2, which were recovered from a single ceramic cache, Feature 415 and its proximity to a Feature 416 a small basin, previously interpreted as a “grog pit” related to ceramic manufacturing. The thin section results tended to weaken such an interpretation for the vessels and associated feature. Matrix Cluster 6 contained examples from several different ware types and also did not correlate to a local clay sample. Included in the cluster were Clay Tempered Vessel Lots CN18 and CN01, Minguannan Vessel Lot MI1, Hell Island Vessel Lot H4, Mockley Vessel Lot MO1, Marcey Creek Vessel Lot MA04, and Wolfe Neck Vessel Lot W3. Given the wide range of types within Matrix Cluster 6, its being considered a “weak” cluster would be expected. The types of ceramics represented in Matrix Cluster 6 spanned from the Early through the Late Woodland in a set of diverse wares that are not typically associated.

The information regarding clay sources gathered from the thin section analysis of representative sherds from the site contained valuable information. The results illustrated clustering within types and between types. In comparison to the local clay samples some significant patterns were noted, especially for the Marcey Creek and Clay Tempered wares, which dominated the site assemblage. The results gathered in this study may also be used for comparison with vessel lots not submitted for thin section, if they display similar characteristics. The study also highlighted the value of procuring local clay samples for comparative purposes.

## EVALUATION OF CERAMIC TYPES

The Hickory Bluff ceramic assemblage was impressive in terms of its content of 7,625 individual sherds and the identification of 86 unique vessel lots. The analysis of the vessel lots allowed for a detailed examination of the full range of variation and similarity within each vessel, each ware type, and the entire assemblage. Ceramic attribute analysis illustrated the continuity of form and individual differences that could be expressed. The analysis also showed how the vessels corroborated and differed from the accepted notions of the established ceramic types of the Delmarva Peninsula and wider Mid-Atlantic region.

### Marcey Creek

Marcey Creek ware, characterized by steatite (or soapstone) temper, a rectangular shape, flat bottom (often with a mat impression), thick vessel walls, and a large vessel orifice to height ratio), represents the earliest ceramic container technology on the Delmarva Peninsula, and the larger Mid-Atlantic region. A total of 1,068 sherds of Marcey Creek ware was recovered, from which 12 vessel lots were identified. These sherds were tempered with steatite or a steatite/schist, which ranged from very soft and soapy to a rough and schist-like texture. The percentage of temper and qualities of the steatite varied between vessel lots. Some vessels from the site contained a much lower percentage of steatite temper. In addition to the steatite or schist, inclusions of fine pieces of clay, small amounts of shell, and iron oxide inclusions were present in some of the Hickory Bluff Marcey Creek vessels. Examination of Marcey Creek sherds from the Marcey Creek and Selden Island sites in Virginia also exhibited a similar range of variation of inclusions and temper quality.

The Hickory Bluff assemblage was similar in vessel form and size to other Marcey Creek ceramics throughout the Mid-Atlantic (Stephenson and Ferguson 1963; Dent 1995). The exterior and interior surfaces of the vessel walls were plain, and the exterior of the bases showed mat impressions. Frequently the interiors of these bases were darkened while the exteriors were distinctly redder in color. The interior blackening and the redder exterior may be the result of initial firing techniques or it may be indicative of vessel function whereby the vessel contents were cooked (or warmed) through indirect heating methods such as stone boiling (Sassaman 1993). Some rim lips were incised with narrow parallel lines perpendicular or oblique to the rim edges.

While Marcey Creek ceramics are commonly regarded as constructed of modeled clay slabs, and the later Selden Island ware constructed of coils (Custer and Silber 1995: 141), there is evidence of frequent overlap in this regard. As described by Egloff and Potter, Marcey Creek vessels with their distinctive flat-bottoms were “either coil-constructed or, occasionally, hand-modeled” (Egloff and Potter 1982:95). This pattern has been noted at other sites that have yielded a large Marcey Creek component, such as the Accokeek Creek site in the Potomac River valley. At that site, the primary method of manufacture was coiling, while only a few sherds appeared modeled by hand (Stephenson and Ferguson 1963: 91). Most recently, Custer and Silber (1995) reported the recovery of a Marcey Creek vessel from the Snapp site in Delaware, which was similar to several Hickory Bluff vessels that were manufactured using wide coils. Custer and Silber (1995) have suggested that this flat-bottomed, coil constructed vessel is transitional between classic Marcey Creek and Selden Island pottery. They suggested further that this implied that the transition to a coiled, cord-marked, conoidal pottery was more gradual than suspected. Perhaps coiling was a well-established trait before the transition to the conoidal shape, and therefore these traits might have different origins (Custer and Silber 1995: 141-142).

At Hickory Bluff, nine of the 12 vessel lots showed evidence of coil construction (Table 14.6). The coils were considered wide on six of these vessels and narrow on two vessel lots. Nine of 12 vessel lots also contained flat bottoms, while one appeared conoidal. Slab construction was only identified for the base of Vessel Lot MA01, which had coil constructed vessel walls, illustrating the overlap of these techniques on a single vessel. Vessel Lot MA05 contained wide coils for both the base and the vessel walls. Both of these vessel lots had flat-bottoms, steatite tempering, and smoothed surface treatments (all typical Marcey Creek ceramic traits). Vessel Lot MA05 also shared some similarities with Vessel Lot MA07 in the forms of the sherds and the nature of the temper material. These traits suggested the use of similar forming

**Table 14.6 Summary of Vessel Lot Attributes for Marcey Creek**

| **Typology** | **Marcey Creek** | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **MA01** | **MA02** | **MA03** | **MA04** | **MA05** | **MA06** |
| **Paste** | | | | | | |
| ***Temper- Type*** | schist/steatite | crushed schist and clay | crushed schist/steatite | steatite/schist | fragmented schist/steatite | schist/steatite |
| ***Inclusions*** | iron oxide | eroded out; holes/slits | iron oxide | sand and iron oxide | iron oxide | iron oxide |
| ***Texture*** | waxy; some grittiness | slightly gritty; soapy | soapy, some grittiness | rough and gritty | soapy | soapy with slight roughness |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | smoothed plain; base showed mat impressions | smoothed over; some narrow scrape marks | plain body; base showed fabric/mat impressions | smoothed plain; impressions of thick fabric/mat | smoothed plain walls; base impressed with fabric/mat | smoothed plain walls; faint impressions on base and lower sides |
| ***Interior*** | smoothed plain | smoothed with fine striation marks evident | smoothed plain | plain | smoothed plain | plain, some light scraping |
| ***Cordage Characteristics*** | thin woven elements | n/a | n/a | n/a | | |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | flattened; narrow marks along lip | Irregular; slightly flattened, scored with parallel lines | flat to slightly rounded; impressions faint to deep | deeply notched in irregular pattern across rim edge | n/a | flattened |
| ***Rim*** | body taper to rim edge | thickened irregularly and slightly everted | body taper to rim edge | tapered below lip edge | n/a | body tapered to edge; slightly everted |
| ***Base/Body-Shape*** | flat base; flared sides | Probably conoidal | flat base | flat base; slightly flared walls | flat base; flared walls | flat base; flared walls |
| ***Construction*** | base was joined slabs walls were wide flattened coils | narrow coils | narrow coils | wide coils | wide coils for base and sides | wide coils |

## Table 14.6 Summary of Vessel Lot Attributes for Marcey Creek (Continued)

| **Typology** | **Marcey Creek** | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **MA07** | **MA08** | **MA09** | **MA10** | **MA11** | **MA12** |
| **Paste** | | | | | | |
| ***Temper- Type*** | steatite/schist | steatite/schist | steatite/schist | finely crushed schist/steatite | heavy schist/steatite | schist/steatite |
| ***Inclusions*** | rounded iron oxide | iron oxide | none | iron oxide | rounded iron oxide | fine sand and iron oxide |
| ***Texture*** | gritty and soapy | gritty/rough, slightly waxy | gritty/rough | | rough, but slightly soapy | rough/gritty |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | smoothed plain walls; base deep impressions from thick fabric/mat | plain or weathered away | plain walls; deep mat impressions on base | plain, with some former light impressions | plain walls that were either smooth or uneven; base was fabric/mat impressed | impressed with close weave fabric/mat |
| ***Interior*** | smoothed plain | smoothed plain, or weathered | smoothed plain | smoothed plain, with some faint impressions | smoothed plain | plain |
| ***Cordage Characteristics*** | | | | | | |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | n/a | n/a | n/a | uneven and rounded | flattened and fabric impressed | n/a |
| ***Rim*** | n/a | n/a | n/a | body tapered to edge and everted | body slightly tapered to edge and slightly everted | n/a |
| ***Base/Body-Shape*** | flat base | n/a | flat base | n/a | flat base | flat base |
| ***Construction*** | wide coils | wide coils | n/a | n/a | coils | n/a |

techniques, some overlap in the material sources used, and the processing of those materials in the manufacture of these two vessels. Vessel Lots MA04, MA06, MA08, MA09, MA11, and MA12 also contained evidence of wide coil construction and/or flat bases. No information on form or construction was available for Vessel Lot MA10.

The remaining two Marcey Creek vessel lots, MA02 and MA03, contained a much lower percentage of temper and had narrower coils. Vessel Lot MA02 was manufactured with narrow clay coils rather than the wide coils or slabs typical of Marcey Creek ceramics, and the mended shape suggested a conoidal body form, as opposed to the typical flat bottomed form. The amount of temper used in Vessel Lot MA02 was minimal as compared to the other Marcey Creek vessels. In addition, the paste contained unmixed clay. The vessel walls were very thin and there were obvious striations on the interior as a result of scraping or wiping.

Vessel Lot MA03 had a flat bottom with very thin basal sherds. The narrowness of the coils of this vessel, especially on the basal sherds, made the form of this vessel less like the Marcey Creek vessel lots that had wider coils or slabs, and more similar to Vessel Lot MA02. Vessel Lot MA03 also contained rounded iron oxide inclusions unevenly distributed within its paste. The paste was unevenly mixed, only moderately compacted, and showed variable concentrations of temper between sherds.

The differences in vessel form, construction, paste, temper amount, range of inclusions, and evident scraping of the interior made Vessel Lot MA02 distinctive and unusual for Marcey Creek ware. This vessel lot could represent a regional variation or transitional vessel associated with the evolution from the flat base to the rounded base and toward the narrow coiled form seen on later wares, such as Selden Island ware. Of the Marcey Creek sherds that were thin sectioned, Vessel Lot MA02 was the only sherd that resembled any of the local experimental clay tiles. This result also suggested that this vessel lot represented a local manifestation or experimentation with accepted manufacturing techniques.

Within the Marcey Creek ceramics found at Hickory Bluff, there was evidence of the continuity of accepted traits, such as steatite and schist tempering, flat bottoms, and similar surface treatments. In addition, there were signs of change toward narrow coil construction, a greater range of paste inclusions, and eventual conoidal form, as evidenced by Vessel Lot MA02. The level of diversity between these vessel lots highlighted the habitually overlooked range of variation often present within standard types.

### Dames Quarter

A small amount of Dames Quarter ware was also found at Hickory Bluff and would fall in the "experimental" group of Early Woodland wares. In general, Dames Quarter ware was similar to Marcey Creek ware in terms of shape, surface treatment, and construction, with the difference being the use of gneiss or hornblende instead of steatite/schist for temper. In total, 13 sherds of this ware were recovered and two vessel lots were represented at Hickory Bluff (Table 14.7).

**Table 14.7 Summary of Vessel Lot Attributes for Dames Quarter**

| **Typology** | **Dames Quarter** | |
|---|---|---|
| **Lot** | **D1** | **HD1** |
| **Paste** | | |
| ***Temper- Type*** | finely crushed hornblende/gneiss | crushed horneblende/gneiss |
| ***Inclusions*** | none | fine sand/grit |
| ***Texture*** | gritty | gritty |
| **Surface Treatment** | | |
| ***Exterior*** | plain | cord impressed |
| ***Interior*** | smoothed plain | smoothed plain |
| ***Cordage Characteristics*** | n/a | final S-twist |
| **Decoration** | None | None |
| **Form** | | |
| ***Lip*** | n/a | n/a |
| ***Rim*** | n/a | n/a |
| ***Base/Body-Shape*** | n/a | n/a |
| ***Construction*** | n/a | n/a |

Unfortunately, the Hickory Bluff sample was too small to provide a full assessment of the type. The two Dames Quarter vessel lots both contained finely crushed hornblende/gneiss as the primary tempering agent. No information about vessel form was available as a result of the fragmentary nature of these sherds. Vessel Lot D1 had smoothed plain interior and exterior surface treatments typical of Dames Quarter ceramics. Vessel Lot HD1, however, contained a cord-impressed surface, although it was not clear if it was the interior or exterior due to the eroded condition of the sherd. This surface impression was atypical for the ware. Hornblende/gneiss raw material was found at the site but was not spatially associated with the Dames Quarter sherds. The presence of this raw material suggested that it was available at the site for use as temper. Interestingly, thin section analysis of a sherd from Vessel Lot D1 showed similarity to one of the locally procured experimental clay tiles. This sherd and tile also showed similarity to Marcey Creek Vessel Lot MA02, which was an unusual vessel lot in that it may have been conoidal in form. The Dames Quarter ceramics may represent local manifestation or imitation of the Marcey Creek ceramic manufacturing style.

## Wolfe Neck

The “experimental” Early Woodland wares were eventually replaced by a more dominant ceramic technology characterized by coil construction, crushed-rock temper, cord marking, and conoidal form (Custer 1989). In the Mid-Atlantic region, similar wares have been referred to as Accokeek, Elk Island, and Vinette I, while on the Delmarva Peninsula they are known as Wolfe Neck ware. These wares were generally similar in form and construction, and delineated based upon variations in surface treatment, percentage of temper, and paste qualities. Wolfe Neck ceramics typically employed crushed quartz as the predominate temper and can exhibit a variety of surface treatments. At Hickory Bluff, 233 sherds and six vessel lots of Wolfe Neck ceramics were identified (Table 14.8).

The Hickory Bluff Wolfe Neck vessel lots exhibited a range of paste characteristics from very smooth, pasty texture to those that included more sand and had gritty texture. The more pasty textured vessel lots included Vessel Lots W1, W2, and to a lesser extent W3. Several of the non-lot sherds also exhibited a similar pasty texture and exhibited a sheen on the surface that closely resembled the Wolfe Neck sherds from the type site (Griffith and Artusy 1977). The sandy texture variety was exhibited by Vessel Lots W3 and W4. Vessel Lot W6 displayed a variety of textures due to the variable inclusion of fine sand within the paste. The range of textures exhibited illustrated the variability present within the type.

Surface treatments also displayed variety for the ware. The exterior surface treatments were generally uniform for the vessel lots, being cord-impressed up to the rim edge. Interestingly, none of the unincorporated Wolfe Neck sherds displayed net-impressed exterior surfaces, a variety commonly found for the type. The complete lack of net-impressed Wolfe Neck ceramics at the site might indicate some functional difference intended for these vessels or local preference for the particular surface treatment. The interior surfaces displayed more variety within the type. Vessel Lot W1, for example, had a criss-cross interior scraping pattern. This scraping was not found on the sandy paste vessels, but was prevalent on the clayey paste sherds. Vessel Lot W1 also had paste characteristics similar to the paste of the Clay Tempered ware vessels, despite the use of quartz tempering. Perhaps this vessel was “transitional” to the Clay Tempered wares, or may reflect the “pasty” quality of a specific local clay. The criss-cross interior scraping pattern also was similar to many Clay Tempered vessels and might also imply a transitional vessel. Vessel Lot W2 also considered a pasty textured vessel, was submitted for thin section analysis and was determined similar to one of the locally procured experimental clay tiles. Vessel Lot W3 was also submitted but did not show a correlation to the local samples.

**Popes Creek**

Popes Creek ware represented another late Early Woodland through early Middle Woodland period ceramic type. This type was more commonly associated with the Chesapeake Bay region and west into Virginia and Maryland. Like Wolfe Neck ware, typical Popes Creek ceramics were coil constructed and conoidal in shape. However, Popes Creek ceramics utilized medium to coarse grain sand as the dominant temper material and tended to have thicker body walls. Net impressions were the dominant exterior surface treatment, while interior surfaces could be smoothed, scraped, or combed. A small collection of Popes Creek ware was recovered at Hickory Bluff: 14 sherds that represented two vessel lots (Table 14.9).

## Table 14.8 Summary of Vessel Lot Attributes for Wolfe Neck

| **Typology** | **Wolfe Neck** | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **W1** | **W2** | **W3** | **W4** | **W5** | **W6** |
| **Paste** | | | | | | |
| ***Temper- Type*** | quartz | crushed quartz | crushed quartz | crushed quartz | crushed quartz | crushed quartz |
| ***Inclusions*** | sand/fiber casts | sand/grit and iron oxide | fine sand/grit and fiber casts | fine sand/grit | fine sand/grit | fine sand/grit |
| ***Texture*** | slightly rough | gritty | gritty | grainy with slight roughness | slightly gritty | rough, gritty |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | cord impressed up to rim edge | deeply cord impressed, covered to rim edge | cord impressed extending to rim edge | impressed with cord-wrapped paddle; up to the rim edge; paddle markings | cord impressed | cord impressed; extended to rim edge |
| ***Interior*** | plain; or criss-cross scraped/narrow parallel lines | cord impressed and finger swipes | cord impressed or smoothed plain, finger swipes | cord impressed at rim; smoothed with faint impressions; finger marks | lightly cord impressed; paddle and/or finger marks | smoothed plain; scrape marks of narrow, parallel lines |
| ***Cordage Characteristics*** | final S-twist | final S-twist | final S-twist | final Z-twist | final S-twist | twined; varied thickness |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | flattened and slightly irregular | rounded and smoothed also pinched on the edge | rounded and smoothed | flattened and smoothed | flattened and impressed | rounded and incompletely smoothed |
| ***Rim*** | straight | straight | tapered at lip edge and slight inversion | straight | n/a | body thinner at edge and widened at lip |
| ***Base/Body-Shape*** | n/a | n/a | flaring from bottom to top | n/a | n/a | n/a |
| ***Construction*** | coils | coils | coils | n/a | coils | n/a |

**Table 14.9 Summary of Vessel Lot Attributes for Popes Creek**

| **Typology** | **Popes Creek** | |
|---|---|---|
| **Lot** | **P1** | **P2** |
| **Paste** | | |
| ***Temper- Type*** | sand and crushed quartz | sand |
| ***Inclusions*** | pebbles | |
| ***Texture*** | gritty and rough | gritty |
| **Surface Treatment** | | |
| ***Exterior*** | net-impressed | deeply net-impressed |
| ***Interior*** | plain with faint scrape marks | smoothed; uneven with faint earlier impressions |
| ***Cordage Characteristics*** | wide spaced net | n/a |
| **Decoration** | None | None |
| **Form** | | |
| ***Lip*** | n/a | n/a |
| ***Rim*** | n/a | n/a |
| ***Base/Body-Shape*** | n/a | n/a |
| ***Construction*** | n/a | n/a |

The small number of Popes Creek sherds recovered at the site provided little comparative information with which to evaluate the type. Both of the vessels recovered were heavily net-impressed and appeared remarkably similar to the "classic" Popes Creek sherds found west of the Chesapeake Bay. Vessel Lot P1 was heavily tempered with sand and some quartz, had a dark ferruginous body color, thick body walls, and interior scraping (although faint). Vessel Lot P2 had a deep red color and had a fine sand temper, deep net impressions on the exterior surface, and smoothed over impressions on the interior surface. No information was available for vessel size, shape, or manufacturing techniques due to the eroded nature of the sherds. Generally, the two Popes Creek vessel lots from Hickory Bluff were consistent with the characteristics that typify the ware, however, the site itself was located outside the area most associated with the type. Interestingly, thin section analysis of a sherd from Vessel Lot P1 showed similarity to one of the locally procured clay experimental ceramic tiles. This result would imply that local manufacture was possible. Some characteristics of Popes Creek ware are evident in the roughly contemporary Clay Tempered ceramics, such as surface treatments that included net roughening, net impressing, scraping, and some finger swiping.

## Clay Tempered Ware

Clay Tempered ceramics were not a widespread phenomena in the Mid-Atlantic region. Some examples included Hanover ware in North Carolina, Croaker Landing ware in Virginia, and a small amount from Abbott Farm, in New Jersey. On the Delmarva Peninsula, three varieties of Clay Tempered ceramics have been reported: Nassawango, Coulbourn, and Wilgus. These were separated primarily on the basis of inclusions in the paste in addition to the clay temper. Nassawango contained crushed rock, usually quartz, as temper, while Wilgus contained a mixture of crushed shell and clay temper. Both Nassawango and Wilgus wares co-occurred with Coulbourn ware, and suggested continuity between the types. These vessels were conoidal in shape, constructed of coils, and exhibited cord or net impressed exterior surface treatments. A variety of interior surface treatments may also be displayed. At Hickory Bluff, a total of 2,598 Clay Tempered ceramic sherds were recovered and 41 individual vessel lots were identified (Table 14.10 and Table 14.11); these constituted the majority of the ceramic assemblage. In an effort to assess the range of variation within the Clay Tempered ceramics, they were analyzed together and not sub-divided into the Coulbourn, Nassawango, and Wilgus types.

The discussion of the Clay Tempered vessels in the report of the Croaker Landing site set forth some interesting suggestions. Their research and analysis in the comparison of the clay inclusions and the matrix clay in Virginia suggested that the inclusions were perhaps simply the result of the failure to grind and mix the clay in preparation for use. Moreover, the "chemist at the Williamsburg Pottery confirmed these findings by stating that clays from the peninsula area, if not thoroughly ground and mixed, will yield color and textural variations similar to those found in the sherds from Croaker Landing" (Egloff et al. 1988: 17). This implied that there was no intentionally introduced temper. Purposeful additions might be indicated by the inclusion of crushed ceramic sherds while some of the clay might be fragments due to incomplete mixing of the paste. At Hickory Bluff, the clay inclusions ranged from large distinctive pellets of clay to fine, small clay inclusions; other sherds appeared to lack temper. Crushed ceramic sherds, or grog, may be present as temper. The amount of sand and other paste inclusions in the Clay Tempered vessels also varied considerably. Examples included a range from well-sorted fine sand, to coarse, unsorted sand with pebble inclusions, to small pieces of iron oxides.

Thin section analysis of 14 varieties of Clay Tempered ceramics confirmed the range of temper indicated by visual inspection. Crushed ceramic sherds, or grog, were identified in six of the samples that represented Vessel Lots CN18 (688-1), CN08 (978-1), CC07 (2129-1), CN10 (2378-3), CN01 (4415-1), and HCC4 (CX107-N). Visual inspection identified grog samples in an additional three, Vessel Lots CN03, CN16, and CC02. Unfired clay inclusions were observed in only two thin section samples that represented Vessel Lots CN02 (262-1) and HCN2 (CX107-ff). Thin section analysis of samples from Vessel Lots CN05 (2255-1) and CN06 (4344-1) identified no temper, while visual inspection of these sherds identified large pieces of clay in the former, and smaller pieces in the latter. The discrepancy between the analyses could be the result of the uneven distribution within the vessel that resulted in the thin section not having clay inclusions to identify. Visual inspection of the Clay Tempered ceramic assemblage identified six examples where the clay-temper appeared so fine as to be nearly untempered: Vessel Lots CC04, CC05, CC08, CC12, HCC2, and HCN2. Large clay temper inclusions were observed in four vessel lots. Small clay inclusions were noted in seven vessel lots, while the mid-range sized clay inclusions were noted in 18 vessel lots.

Three vessel lots were inconsistent and outside the typical range exhibited by the rest of the Clay Tempered ceramic assemblage. Vessel Lot CC11 included a higher relative content of sand/grit, approximately 20 percent of the paste, than was typical for the Clay Tempered vessel

## Table 14.10 Summary of Vessel Lot Attributes for Clay Tempered, Cord Marked

| **Typology** | **Clay Tempered Cord Marked** | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **CC01** | **CC02** | **CC03** | **CC04** | **CC05** | **CC06** |
| **Paste** | | | | | | |
| ***Temper- Type*** | clay | clay and 2 other sherds | clay | clay (minimal) | clay (minimal) | small clay/grog |
| ***Inclusions*** | sand/grit and small pebbles | some sand | fine sand/grit | fine sand, clay fragments, 1 iron oxide fragment | rounded iron oxide and some fine sand | very fine sand/grit |
| ***Texture*** | varied from smooth to slightly gritty | smooth and pasty | slightly gritty | smooth and pasty | smooth and pasty with increasing grittiness as descend down vessel body | smooth with slightly grainy |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | deeply cord-impressed, with some smoothing and scraping with thin parallel striations | cord-impressed with some smoothing | cord-impressed then smoothed and scraped with tool that left narrow parallel lines | cord-impressed | cord-impressed; deeply on body and smoothed toward rim | crisscross cord-marked |
| ***Interior*** | cord-impressed similar to exterior and scraped with tool leaving striated patterns | smoothed and scraped with tool that left parallel striation lines in crisscross pattern | scraped with tool that left fine parallel lines | smoothed, fine striation lines | smoothed with some gouge marks or cord-marking on some sherds | scraped with tool that left thin parallel lines, in crisscross pattern |
| ***Cordage Characteristics*** | loose-twined formed with S-twist | twined into loose net/fabric, formed with S-twist | twined into loose net/fabric, formed with S-twist - thin to moderate cords | loosely twined or woven; Z-twist | loosely-twined formed with S-twist | fine cordage wrapped irregular intervals formed with final S-twist |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | | n/a | n/a | n/a | impressed then smoothed, irregular flattened edge | rounded to slightly flattened; smoothed over paddle impressions |
| ***Rim*** | | n/a | n/a | n/a | slightly inverted | straight taper |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a | n/a | n/a |
| ***Construction*** | coils | n/a | coils | coils | n/a | coils |

**Table 14.10 Summary of Vessel Lot Attributes for Clay Tempered, Cord Marked (Continued)**

| **Typology** | **Clay Tempered Cord Marked** | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **CC07** | **CC08** | **CC09** | **CC10** | **CC11** | **CC12** |
| **Paste** | | | | | | |
| ***Temper- Type*** | clay and sand/grit | clay (minimal) | small clay fragments | small clay and/or grog | sand/grit | clay (minimal) |
| ***Inclusions*** | pebbles | sand | sand and single pebble of red chert | sand | sandstone chunks and iron oxide fragments | small clay and fine sand/grit |
| ***Texture*** | rough | smooth and pasty | smooth and pasty | smooth and pasty | gritty | smooth and pasty |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | cord-impressed | cord-impressed | cord-impressed | lightly cord-impressed and partially smoothed over | cord-impressed | cord-impressed, deeply up to rim edge |
| ***Interior*** | varied: cord-impressed, smoothed, or scraped with tool that left narrow parallel lines | scraped with tool that left narrow parallel lines, irregular crisscross | net-impressed, deeply and slightly smoothed | gouged deeply with parallel strokes irregularly spaced | cord-impressed, deeply with some finger swipes | smoothed plain, light striation marks |
| ***Cordage Characteristics*** | fine to medium formed with final S-twist | S-twist and untwisted open flat fibers also visible | final S-twist; netting widely spaced large knots | final S-twist | final S-twist | twined loose net/fabric formed with Z-twist |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | n/a | n/a | n/a | n/a | n/a | rounded and smoothed plain |
| ***Rim*** | n/a | n/a | n/a | n/a | n/a | slightly tapered straight to lip |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a | n/a | n/a |
| ***Construction*** | n/a | coils | coils | coils | coils | coils |

**Table 14.10 Summary of Vessel Lot Attributes for Clay Tempered, Cord Marked (Continued)**

| **Typology** | **Clay Tempered Cord Marked** | | | | |
|---|---|---|---|---|---|
| **Lot** | **CC13** | **HCC1** | **HCC2** | **HCC3** | **HCC4** |
| **Paste** | | | | | |
| ***Temper- Type*** | clay or grog | clay | clay (minimal) | grog and clay and sand/grit | small clay fragments |
| ***Inclusions*** | sand and pebbles | sand/grit and iron oxide | clay and fine sand, occasional iron oxide | pebbles and iron oxide | sand and iron oxide and fibercasts |
| ***Texture*** | slightly gritty | pasty with slight roughness | smooth and pasty | gritty | gritty |
| **Surface Treatment** | | | | | |
| ***Exterior*** | cord-impressed, vertically to rim edge | cord-impressed and partially smoothed and scraped with tool that left narrow parallel lines | cord-impressed | cord-marked | cord-marked extended to rim edge oriented vertically and paddle impressions |
| ***Interior*** | cord-marked, parallel to rim edge in horizontal position | cord-impressed | scraped with tool that left narrow parallel lines | scraped in crisscross pattern of narrow parallel lines, some partially smoothed | smoothed over prior scraping |
| ***Cordage Characteristics*** | final S-twist | loose-twined fabric made with final S-twist | final S-twist | final S-twist and range of cordage thickness | final S-twist |
| **Decoration** | None | None | None | None | None |
| **Form** | | | | | |
| ***Lip*** | rounded and smoothed | n/a | n/a | n/a | Rounded and slightly flattened |
| ***Rim*** | n/a | n/a | n/a | n/a | Straight |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a | Conoidal |
| ***Construction*** | coils | coils | coils | coils - medium | coils |

## Table 14.11 Summary of Vessel Lot Attributes for Clay Tempered, Net Impressed

| **Typology** | **Clay Tempered Net Impressed** | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **CN01** | **CN02** | **CN03** | **CN04** | **CN05** | **CN06** |
| **Paste** | | | | | | |
| ***Temper- Type*** | large clay pieces | rounded clay | clay and 1 sherd | clay | large clay pieces | clay |
| ***Inclusions*** | fine sand/grit and occasional pebble | fine sand/grit and pebbles | fine sand/grit and iron oxide | fine sand/grit | sand/grit | sand |
| ***Texture*** | gritty | smooth and pasty | slightly gritty | slightly rough | smooth and pasty | smooth and pasty with slight grittiness |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | net-impressed, deeply with some overlapping and net-roughening with some areas smoothed or lightly scraped showing parallel lines up to lip edge | net-roughened up to rim lip and faintly smoothed | impressed with net/cord-wrapped cord and partially smoothed | net-impressed and slightly smoothed | net-impressed, deeply and net-roughened in some areas, other areas flattened | impressed with close weave net/fabric up to the lip edge - repeated and created fine patterning |
| ***Interior*** | net-impressed, then lightly smoothed, some sherds scraped with tool that left narrow parallel lines | net-impressed then smoothed and scraped with tool that left narrow parallel lines | smoothed incompletely | net-impressed then somewhat smoothed | smoothed and some scraping with tool that left narrow parallel lines | smoothed with faint former impressions |
| ***Cordage Characteristics*** | net tightly arranged formed with final S-twist, fine single strands | fine cordage with final S-twist, widely spaced knots in net | wide-spaced thin cord net | widely-spaced knots formed of double cords with a final S-twist | n/a | fine cordage made with final S-twist |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | flattened and smoothed with faint former impressions | flat to slightly rounded | n/a | n/a | n/a | impressed then pinched and incised to form a row of scallops on rim edge |
| ***Rim*** | body tapered to lip edge, then straight | tapered to rim edge, rim slightly everted | na | n/a | n/a | straight |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a | n/a | n/a |
| ***Construction*** | n/a | n/a | coils | coils | n/a | n/a |

**Table 14.11 Summary of Vessel Lot Attributes for Clay Tempered, Net Impressed (Continued)**

| **Typology** | | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **CN07** | **CN08** | **CN09** | **CN10** | **CN11** | **CN12** |
| **Paste** | | | | | | |
| ***Temper- Type*** | small clay and sand/grit | clay | clay | clay and fine sand/grit | clay | large clay/grog |
| ***Inclusions*** | small pebbles - mostly quartz | fine sand and few pebbles | fine sand | pebble impressions, but no pebbles | fine sand and pebbles | iron oxide and sand few pebbles |
| ***Texture*** | gritty | slightly gritty | very slightly gritty | slightly gritty | very slightly gritty | slightly gritty |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | net-impressed deeply, highly textured and partially smoothed and scraped with a tool that left narrow parallel lines | net-impressed deeply and net-roughened then partially smoothed | net-impressed, deeply | net-impressed layered on paddle resulted in complex pattern | net-roughened, deep textured surface | net-impressed |
| ***Interior*** | net-impressed, smoothed and scraped with tool that left narrow parallel lines | smoothed, irregular scrape marks left pattern of fine parallel lines | smoothed with faint former impressions | smoothed, portions scraped with a tool that left channel or gouge marks, and striation marks | impressed then smoothed, some portions scraped with tool that left narrow parallel lines in irregular criss-cross | smoothed incompletely with faint impressions |
| ***Cordage Characteristics*** | tightly spaced, large knots linear arrangement, formed with final S-twist | n/a | n/a | final S-twist | n/a | large knots and widely spaced netting |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | n/a | n/a | n/a | flattened and uneven | n/a | n/a |
| ***Rim*** | n/a | n/a | n/a | body tapered straight to lip, finger depressions | n/a | n/a |
| ***Base/Body-Shape*** | n/a | n/a | n/a | wider at rim than base – conoidal | n/a | n/a |
| ***Construction*** | coils | coils - paddle impressions | coils | coils | coils - paddle impression | coils |

**Table 14.11 Summary of Vessel Lot Attributes for Clay Tempered, Net Impressed (Continued)**

| **Typology** | | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **CN13** | **CN14** | **CN15** | **CN16** | **CN17** | **CN18** |
| **Paste** | | | | | | |
| ***Temper- Type*** | clay/grog | small clay | small clay | clay and 1 sherd | clay | clay |
| ***Inclusions*** | sand/grit and iron oxide | fine sand and soft black pieces | fragments of iron oxide and fine sand, one pebble | sand | iron oxide and sand | very fine sand |
| ***Texture*** | gritty | smooth and pasty | smooth, with slight roughness | slightly gritty | smooth and pasty | gritty |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | net-impressed, deeply | net-roughened, slightly flattened, highly textured | net-impressed, deeply and slightly smoothed | net-impressed or net-roughened | impressed with net/fabric, moderately continuous low-relief pattern to lip edge | net-impressed, deeply up to lip edge |
| ***Interior*** | scraped | scraped tool left criss-cross of fine parallel lines | net-impressed, deeply and net-roughened | plain or scraped with tool that left narrow parallel lines in criss-cross pattern | smoothed with undulations from earlier scraping | smoothed incompletely, faint net-impressions |
| ***Cordage Characteristics*** | knots widely spaced cordage formed by final S-twist | n/a | net elements widely spaced cordage formed with final S-twist | n/a | closely spaced net/fabric elements | final S-twist |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | n/a | n/a | n/a | n/a | rounded | paddle-impressed then flattened and smoothed incompletely |
| ***Rim*** | n/a | n/a | n/a | n/a | straight | body tapered straight |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a | n/a | n/a |
| ***Construction*** | n/a | coils | coils - "sloping overlap" | coils - finger indentations visible | coils | coils |

**Table 14.11 Summary of Vessel Lot Attributes for Clay Tempered, Net Impressed (Continued)**

| **Typology** | | | | | | |
|---|---|---|---|---|---|---|
| **Lot** | **CN19** | **CN20** | **CN21** | **CN22** | **HCN1** | **HCN2** |
| **Paste** | | | | | | |
| ***Temper- Type*** | clay | quartz, sand, and clay | infrequent clay/grog and sand | clay and sand | clay (minimal) | large clay |
| ***Inclusions*** | dark grog-like and fine sand/grit and iron oxide | iron oxide | none | pebble, iron oxide and 2 fiber-casts | fine sand and rounded iron oxide | fine sand and 1 pebble |
| ***Texture*** | varied smooth to slightly gritty | rough | rough | gritty | pasty with only slight roughness | pasty with slight roughness |
| **Surface Treatment** | | | | | | |
| ***Exterior*** | deeply net/fabric impressed extended to rim edge, some slightly smoothed | moderately net/fabric impressed and slightly smoothed | net-impressed, patterned surface | net-impressed | net-impressed | multiple net-impressed, extended to edge of rim |
| ***Interior*** | net-impressed, smoothed on some | smoothed with faint earlier impressions | smoothed incompletely, with faint earlier impressions and finger depressions | smoothed and also scraped with a tool that left narrow parallel lines | incompletely smoothed over net-impressions, faint tool lines from scraping | scraped with that left narrow parallel lines, other portions smoothed |
| ***Cordage Characteristics*** | final S-twist | n/a | tightly spaced netting with final S-twist | final S-twist | netting, closely-spaced knots | netting widely-spaced formed with final S-twist cordage |
| **Decoration** | None | None | None | None | None | None |
| **Form** | | | | | | |
| ***Lip*** | paddle-impressed then smoothed over and flattened | n/a | flattened with paddle along lip edge | lip edge was rounded and somewhat flattened; impressed then smoothed | n/a | rounded and smoothed, pinched in one area |
| ***Rim*** | slightly inverted | n/a | straight | rim body tapered straight to edge | n/a | rim tapered to lip edge, walls rose straight |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a | n/a | conoidal |
| ***Construction*** | coils | coils - paddle impressions | n/a | coils | coils | coils |

lots. This sand was generally fine in size, but larger pieces of sandstone (6.0-7.0 mm) were included as well. The paste exhibited a general "lumpiness" which may be due to larger pieces of unblended clay that matched the matrix clay. These "lumps" were characteristic of several other Clay Tempered vessel lots. Vessel Lot CN20 was tempered with crushed quartz, sand, and pieces of clay each accounting for approximately 5 percent of the paste, as well as inclusions of iron oxide. Its texture was more well-mixed and compact than the texture displayed by the more typical Clay Tempered vessel lots, which had loose and convoluted bodies. The addition of crushed quartz to the clay temper in this vessel was unique within the Hickory Bluff collection. Vessel Lot CN21 was tempered with infrequent pieces of clay. The quantity of clay temper in this vessel lot was small but the amount of sand was greater.

The range of the temper quality and quantity displayed within the Clay Tempered ceramics was significant. Along with the range of inclusions noted between vessels, it demonstrated the wide variety found within the type. Individual sherds within mended groups sometimes displayed different paste inclusions or amounts, which suggested the variation that could be present even within a single vessel. The variety within lots may have reflected less careful manufacture or incidental inclusions within types of clay utilized for the vessel.

Information about vessel size and shape was limited for the assemblage. Despite the higher frequency of sherds and vessel lots, the assemblage was still very fragmentary. A conical shape was determined for Vessel Lot CN10, while Vessel Lots HCC4 and HCN2 were described as conoidal shape, both typical for Clay Tempered ceramics. Clear coil construction was noted on 32 of the 41 vessels, and examples of both paddle impressions and finger swiping from joining the coils were found on these vessels. Further information on vessel construction was too limited for comparative data, but examples of both overlapping, obtuse and sharp, almost 90-degree coil joints were observed in the assemblage. Some coils were lightly joined, while others were pressed down, overlapped, and displayed channel formed edges. Vessel Lot CN15 contained both obtuse and sharp joining edges. This variety suggested that several manufacturing techniques were employed in the manufacture of vessels of the same ware.

A comparison of the averaged sherd thickness for each Clay Tempered vessel lot displayed a range from the 6.8 mm obtained for Vessel Lot CC12 to 14.3 mm obtained for Vessel Lot CN04. The overall average thickness for the type was 10.37 mm. Despite the overall range, the majority of vessel lots had thickness in the range of 8.5-12 mm. The absence of separate modes in this range suggested the overall relatedness of these vessels in terms of thickness. Slight variations exhibited could be attributed to such things as the number of sherds used to calculate the average and which part of the vessel they represented. The Clay Tempered ceramics were thicker than average for the entire Hickory Bluff ceramic assemblage.

The two main exterior surface treatments displayed by the Clay Tempered ceramics were cord-impressed and net-impressed varieties. There were 17 cord-impressed vessel lots, which represented 41 percent of the Clay Tempered vessel lots. The 24 net-impressed vessel lots accounted for 59 percent of the Clay Tempered vessel lots. Within these general categories, variation was present. Within the cord-impressed vessel lots, three examples of deeply impressed cords, one lightly impressed, six examples of partial smoothing of the impressions, and three examples of scraping over the cord impressions were recorded. Vessel Lots CC01, CC03, and HCC1 contained both smoothing and scraping on the exterior surfaces and the differences may have been related to the part of the vessel the sherds represented (i.e., smoothed more toward rim and scraped lower on the body). The net-impressed Clay Tempered vessel lots also displayed variations of type and quality of the exterior surface treatment. Deeper net impressions or net-roughening was observed on 14 vessel lots. Partial to moderate smoothing of impressions was noted on eight vessel lots, while some scraping was noted on only two vessel lots. As with the cord-impressed examples, some vessel lots displayed combinations of both smoothing and scraping, and partial flattening of the impressions that may relate to the portion of the vessel represented by a specific sherd.

The interior surface treatments for the Clay Tempered ceramics also displayed variation within and between vessel lots. Evidence of only smoothing of impressions, which ranged from light to moderate, was noted on thirteen of the 41 Clay Tempered vessel lots. Evidence of only scraping was noted on nine on the 41 vessel lots. The majority of the Clay Tempered assemblage showed evidence of both smoothing and scraping on the interior surfaces (15 vessel lots). In general, the type of exterior impression, cord or net, was also present on the interior surface, albeit the interior surfaces displayed more smoothing and/or scraping of these impressions. Vessel Lot CC09 was unique within the assemblage, as it contained a cord-impressed exterior surface and a net-impressed interior surface treatment. Vessel Lot CN15 exhibited a unique interior surface treatment as well; it was deeply net-impressed or net-roughened with no smoothing or scraping of the impressions evident. The scraping that was noted on various vessel lots was accomplished with a tool that left rows of narrow, parallel lines in a criss-cross pattern (Figure 14.46). The scraping pattern was distinctive and was a hallmark trait of the Clay Tempered type evident on a total of 24 vessel lots. The scraping created a textured surface and could be found in irregular, horizontal, or vertical orientations.


**Figure 14.46 Example of Interior Criss-Cross Patterning on Clay Tempered Ceramics (CN14)**

The range of traits evidenced by the Clay Tempered vessel lots seemed to cross between the dominant cord and net impressed varieties. That is, specific traits did not seem to correlate to the dominant surface treatment. One exception was noted with the subset of vessel lots containing minimal amounts of visible clay temper, as five of the six had cord-impressions. Due to the small number of examples, though, it was unclear if this pattern was significant. Another interesting exception was noted within cordage characteristics. Of the 41 vessel lots, final twist could be identified on 30 vessel lots. Of these, 28 (93 percent) were S-twist. The two examples of Z-twist cordage were both cord-impressed examples, Vessel Lots CC04 and CC12. Both of these vessel lots also represented examples of the minimally-tempered variety noted within the type. Although other minimally-tempered examples contained S-twist cordage, the correlation between Z-twist and the minimally-tempered vessel lots would be a pattern worth exploration in larger comparative datasets for Clay Tempered wares in the region.

The Clay Tempered ceramic vessel lots displayed a range of variation within their attributes. This range, however, was considered to be acceptable for the type as the 41 vessel lots displayed overwhelming similarity overall in terms of temper, inclusions, thickness, surface treatments and construction. Variations in attribute values for specific lots could be due to different vessel functions (e.g., cooking or storage vessels) or stylistic differences between families or individual potters.

In relation to the regional names given to Clay Tempered ceramics in the literature, the overwhelming majority of the Hickory Bluff assemblage would be typed as Coulbourn ware. Vessel Lot CN20 was an example of combined crushed quartz and clay tempering that suggested Nassawango ware. No vessel lots were noted that would occur in the Wilgus category, although individual sherds unincorporated into vessel lots contained Wilgus characteristics. However, as seen within the actual vessel lots, a wide variation in attributes could be encompassed within a single vessel lot, without that lot needing to be placed in another "type" of ware.

Several examples were noted within the vessel lots that seemed to blend characteristics more typical of other ceramic wares. Three vessel lots contained different traits that were reminiscent of Popes Creek ware, and shared attributes between the two wares have been noted by other researchers such as Wise (1975). Vessel Lot CN08 was thick and contained an elevated percentage of sand within the paste roughly similar to Popes Creek. Vessel Lot CC06 contained an elevated percentage of sand and darker body color that recalled Popes Creek, but cord-markings that were more typical of Clay Tempered wares. Vessel Lot CN07 had the inclusion of larger pebbles that was atypical of the other Clay Tempered vessel lots and more similar to Popes Creek wares.

Other vessel lots showed similar attributes to other wares. For example, Vessel Lot CC11 was already noted for its unusual temper attributes. In addition, the interior surface treatments were similar to the interior cord-markings and finger smoothing observed on the Wolfe Neck vessel lots. This vessel lot may represent a transitional or experimental vessel that blended attributes of two dominant wares. Similar characteristics persisted into the Mockley vessel lots from the site and will be discussed below. The overlapping of traits between the several different wares suggested a degree of continuity in manufacturing techniques.

## Mockley

Mockley ware was a Middle Woodland ware that had a wide distribution throughout the Mid-Atlantic region. It was defined by the predominant use of shell as tempering material, relatively large vessel size, and thick sherds. Vessels were coil constructed and generally conoidal in form, with flattened or impressed lips. Surface treatments exhibited a wide range and included smoothed, cord marked, and net impressed varieties.

Nine vessel lots of Mockley ware were identified from a total of 74 Mockley ceramic sherds (Table 14.12). The pastes of these sherds exhibited a variety that ranged from very smooth and fine to sandy. The exterior surfaces were either cord-marked or net roughened. Interior surfaces were plain or marked with a similar, distinctive scraping that was reminiscent of treatments displayed on the Clay Tempered wares. The Hickory Bluff Mockley ceramics displayed both consistency with the typical characteristics of the type, as well as variations consistent with other ware types suggesting a degree of overlap or continuity between the types. All of the Mockley vessel lots exhibited evidence of shell tempering; however, the range of inclusions present within the paste of the vessels was different. Six out of the nine vessel lots included clay and/or iron oxide inclusions within the paste, inclusions that were more typically characteristic of the Clay Tempered vessels within the assemblage. These inclusions were especially pronounced in Vessel Lot MO2, which had a smooth and pasty texture and less sand than the other Mockley vessel lots. Vessel Lots MO3, MO4, and MO8 also had pasty textures. In particular, Vessel Lot MO4 was the only Mockley lot to contain no sand within the paste, which created a sheen on the surface reminiscent of the Clay Tempered wares. On the other hand, many of the vessels contained a high proportion of sand, which created gritty textures and friable surfaces. The sandier variety included Vessel Lots MO5, MO6, and MO7. The high sand content within the paste of Vessel Lot MO5 was particularly noteworthy, as it made this vessel heavier than normal. Vessel Lot MO7 was the most sandy and friable of the Mockley vessel lots, and it also included trace amounts of iron oxide inclusions that were not generally found on the sandier vessels.

In terms of sherd thickness, the Mockley vessel lots displayed a diverse range. Vessel Lots MO1, MO3, MO4, and MO8 had sherd thicknesses (6.5-8.5 mm) that were considered thinner than typical for Mockley vessels. More typical sherd thicknesses (9.0-13.0 mm) for the type were recorded for Vessel Lots MO5, MO7, and HMO1. This range of thickness could be an indication of the evolution of the type, gradually becoming thinner and more like Townsend ceramics. However, it could also be the normal range of variation of traits observed within the Mockley assemblage.

The surface treatments found on the Mockley vessel lots, both exterior and interior, also showed a range of diversity. Four vessel lots had cord-marked exteriors, while the other five had net/fabric impressed or roughened exterior surfaces. The interior surface treatments ranged from smoothed (3 vessels) to highly scraped (4 vessels), with a tool that left distinct rows of narrow, parallel lines across the surface. This type of treatment was more often associated with Clay Tempered vessels. Vessel Lot MO1 exhibited evidence for both smoothing and scraping on the interior surface, which was unique within this assemblage. Vessel Lot HMO1 had cord-marking on the interior that was more evenly spaced than that observed on the exterior and contained no smoothing. The internal scraping was highly patterned on Vessel Lots MO1, MO2, MO3, and MO7.

## Table 14.12 Summary of Vessel Lot Attributes for Mockley

| **Typology** | **Mockley** | | | | |
|---|---|---|---|---|---|
| **Lot** | **MO1** | **MO2** | **MO3** | **MO4** | **MO5** |
| **Paste** | | | | | |
| ***Temper- Type*** | shell | crushed shell | shell | crushed shell | crushed shell |
| ***Inclusions*** | sand/grit; fiber cast | clay; fine sand; iron oxide | iron oxide and some sand/grit | iron oxide | fine sand, and iron oxide |
| ***Texture*** | slightly rough | smooth and pasty with slight roughness | gritty, edges rounded and eroded | smooth and pasty | gritty and friable |
| **Surface Treatment** | | | | | |
| ***Exterior*** | cord marked; vertical finger swiping | net impressed; highly patterned | net-roughened | impressed with net/fabric | cordage impressed |
| ***Interior*** | smoothed plain; scraped with fine parallel lines, both vertically and horizontally | scraped; left criss-cross of narrow, parallel lines | scraped repeatedly leaving fine, parallel striations, leaving pattern of criss-cross at different angels | smoothed flat, few random striation marks | smoothed |
| ***Cordage Characteristics*** | S-twist | tightly spaced netting; fine cordage with final S-twist | S-twist | S-twist | S-twist |
| **Decoration** | rim impressed with parallel single cords angled diagonally up to the rim edge | None | None | None | None |
| ***Form*** | | | | | |
| ***Lip*** | lip edge spalled; slightly protruding | n/a | n/a | n/a | n/a |
| ***Rim*** | wall tapered up to the edge, then rose straight to the edge | n/a | n/a | n/a | n/a |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a | n/a |
| ***Construction*** | n/a | coils | coils | n/a | coils |

## Table 14.12 Summary of Vessel Lot Attributes for Mockley (Continued)

| **Typology** | | | | |
|---|---|---|---|---|
| **Lot** | **MO6** | **MO7** | **MO8** | **HMO1** |
| **Paste** | | | | |
| ***Temper- Type*** | shell | shell | crushed shell | shell |
| ***Inclusions*** | very fine sand | sand/grit and iron oxide | fine sand | sand/grit and iron oxide |
| ***Texture*** | gritty and sandy | gritty | slight grittiness, mostly smooth | granular |
| **Surface Treatment** | | | | |
| ***Exterior*** | impressed with cordage, vertically at angle to rim edge | net impressed | impressed with net/fabric and smoothed over | cord-marked; partially smoothed |
| ***Interior*** | smoothed | barely smoothed; parallel lines from scraping created groove | narrow parallel lines from scraping; partially smoothed | cord-marked; more closely together than exterior and no smoothing |
| ***Cordage Characteristics*** | fine cords; S-twist | n/a | n/a | final S-twist |
| **Decoration** | None | None | None | None |
| **Form** | | | | |
| ***Lip*** | n/a | n/a | n/a | n/a |
| ***Rim*** | n/a | n/a | n/a | n/a |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a |
| ***Construction*** | coils | coils | coils | coils |

In some attributes, the Mockley ceramics from Hickory Bluff appeared to represent a continuity of traits from the earlier Clay Tempered wares to some later Townsend characteristics. Vessel Lot MO1 was unique and exhibited a combination of traits characteristic of several different wares. This vessel was thinner than a typical Mockley vessel. The attention to detail displayed in the impressed single cord decoration also seemed later, and was reminiscent of Townsend incised parallel lines. The finger-swiping on the exterior surface was similar to that seen on Popes Creek ware. At the same time, the internal scraping pattern seemed elaborate, more like a Clay Tempered ceramic trait. However, there were no clay or iron oxide inclusions in this vessel lot. The thinness of the sherds and the attention to detail may have meant that this vessel was designated for a special function.

Several other vessels exhibited attributes typically associated with Clay Tempered vessels. Vessel Lot MO2 was clearly and abundantly shell-tempered, while the inclusions of pieces of clay, the criss-cross scraping on the interior, and the fine net-impressions on the exterior all created an overlap of traits characteristic of the Clay Tempered wares. Vessel Lot MO3 was relatively thin for a Mockley vessel, although the surface treatment and the large leached shell holes were typical for that ware. The inclusion of iron oxide fragments was reminiscent of the pastes of several Clay Tempered ware vessels. Vessel Lot MO4 also was thin for Mockley ware. In some respects, such as the pasty body, the thin walls, the scraped and smoothed interiors, and the net/loose fabric surface treatment, this vessel lot was similar to some of the Clay Tempered vessel lots. The addition of shell for temper distinguished these vessels from the Clay Tempered wares.

Vessel Lot MO3 was also comparable to Townsend Vessel Lot HT1 based on the inclusion of iron oxide fragments in its paste and a similar thinness of the vessel walls. However, Vessel Lot HT1 included a lower percentage of iron oxide than Vessel Lot MO3.

Vessel Lot HT1 was also slightly more gritty and contained pieces of crushed quartz. Vessel Lot HMO1 also had a heavy concentration of iron oxide within its paste. Most of the Hickory Bluff cord-marked Mockley vessel lots were somewhat gritty in texture and Vessel Lot HMO1 occurred within that range. This vessel lot exemplified the thickness of a more typical Mockley ware vessel. Vessel Lot MO8 was a typical Mockley ware vessel with its net-impressed reddish/buff colored body. However, it was generally thinner than usual for a Mockley vessel and the shell pieces appear individually throughout the paste, not in clusters.

Vessel Lot MO5 contained a high sand content within the paste. Its surface treatment was similar to Vessel Lot MO1, but was made with finer cordage, while the thicker sherds that comprised Vessel Lot MO5 were more typical of Mockley ware. The paste of Vessel Lot MO7 was most similar to Vessel Lot MO5, which was a cord-marked vessel. In terms of surface treatment, Vessel Lot MO7 was more similar to Vessel Lot MO2. Each was net-impressed on the exterior surface and scraped on the interior with a tool that left a pattern of narrow parallel lines. Each of these vessels was composed of different pastes; one was sandy and the other softer and more pasty. Vessel Lot MO7 clearly displayed the variety encountered within the ware, and the diversity in the correlation between pastes and surface treatments.

The overlapping of manufacture traits, such as roughened net impressing, finger swiping and heavy scraping evident from the earlier wares (Wolfe Neck, Clay Tempered, and Popes

Creek) into the Middle Woodland wares like Mockley suggested continuity through these wares. Cordage characteristics were also similar between these wares, being predominately S-twist or in the case of the Mockley assemblage, exclusively S-twist. The Mockley sherd submitted for thin section analysis was from Vessel Lot MO1, which displayed characteristics that crossed several types. Although it did not match any of the locally derived experimental clay tiles, it did show source similarity to several diverse ware types: Marcey Creek, Wolfe Neck, Clay Tempered, Hell Island, and Minguannan. The range of variation observed within the Mockley assemblage at Hickory Bluff highlighted the diversity often found within and between ceramic types.

**Hell Island**

Hell Island ceramics represented a late Middle Woodland type with a more limited distribution, typically being found in the northern Delmarva Peninsula. This ware employed finely crushed quartz as the predominant temper material and often contained mica flakes as a secondary inclusion and fine sand or grit within the paste. These vessels were conoidal in shape, constructed of coils, and tended to have thin vessel walls. A variety of surface treatments have been observed on Hell Island ceramics from fabric to cord impressed. At Hickory Bluff, a total of 107 sherds and four vessel lots represented Hell Island ceramics (Table 14.13). The vessel lots displayed degrees of variation that suggested diversity within the type.

The small number of Hell Island sherds recovered did not allow for a full assessment of this ceramic type, but did contain important comparative information for the general site assemblage. All four vessels contained crushed quartz as the primary temper material, typical of the ware. Vessel Lots H3 and H4 also contained fine sand and grit as a secondary temper material, also common for the type. In addition, all but Vessel Lot H3 contained mica flake inclusions within the paste, separating it from the rest of the Hell Island assemblage. No information was available for vessel sizes or shape, but Vessel Lots H1 and H3 showed clear coil construction.

Vessel Lots H1 and H2 exhibited attributes that suggested they were more carefully manufactured. Vessel Lot H1, for instance, was one of the few vessels in the collection that was impressed with a close-weave fabric. In addition, the extensive smoothing on the interior, the well-mixed and compacted paste, and the thin body sherds suggested that it was carefully manufactured. Vessel Lot H2 also was a thin-walled vessel that had been impressed with closely-wrapped, fine cords that formed a narrow criss-crossing pattern on the surface. It had a well-blended, compact paste that contained finely crushed quartz and more sand than Vessel Lot H1.

Less careful manufacture was suggested by several attributes observed in Vessel Lots H3 and H4. The sherds in Vessel lot H3 were relatively thick more heavily tempered than those of the other Hell Island lots, with more and larger fragments of crushed quartz. Vessel Lot H3 also had no careful attention to the rim, which remained irregular and unsmoothed. The sherds from near the base area of the vessel exhibited wear or erosion. The area near the base was redder in color as opposed to the darker tones evident near the mouth. All of these attributes

## Table 14.13 Summary of Vessel Lot Attributes for Hell Island

| **Typology** | **Hell Island** | | | |
|---|---|---|---|---|
| **Lot** | **H1** | **H2** | **H3** | **H4** |
| **Paste** | | | | |
| ***Temper- Type*** | crushed quartz | crushed quartz | crushed quartz and sand | crushed quartz and sand/grit |
| ***Inclusions*** | mica | mica and sand | none | mica flakes |
| ***Texture*** | slight roughness | gritty | gritty | gritty |
| **Surface Treatment** | | | | |
| ***Exterior*** | fabric impressed | impressed with cord-wrapped paddle' narrowly spaced criss-cross pattern | impressed with cord-wrapped paddle, covered up to rim edge; cross paddling gave criss-cross pattern | n/a |
| ***Interior*** | smoothed; with fine, parallel striation lines | smoothed plain | smoothed, with some scraping with narrow, parallel striations | cord-marked |
| ***Cordage Characteristics*** | close woven fabric, "A" line very thin and fine | thin and fine cordage formed with S-twist | fine cordage formed with Z-twist, wrapped with irregular separation | medium-sized formed with S-twist |
| **Decoration** | None | None | None | None |
| **Form** | | | | |
| ***Lip*** | n/a | n/a | flattened | n/a |
| ***Rim*** | n/a | n/a | straight | n/a |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a |
| ***Construction*** | coils | n/a | coils | n/a |

suggested a more utilitarian vessel than the other Hell Island lots. Vessel Lot H3 was atypical for Hell Island ceramics and seemed to share characteristics associated with Wolfe Neck ware in attributes such as sherd thickness, a less finely crushed quartz temper, and redder paste suggesting an oxidizing firing technique. In addition, Vessel Lot H3 was the only Hell Island vessel at the site that did not contain mica flakes within the paste. On the other hand, Vessel Lot H3 had cordage characteristics more similar to the wider Hell Island type. These included the finely spun Z-twist cordage used to impress the vessels and the cross-paddling that created the distinctive criss-cross cordage pattern across the exterior surface. This pattern was similar to that observed on sherds from the Hell Island site, as well as on a more standard Hell Island vessel lot at Hickory Bluff, Lot H2 (although that lot exhibited S-twist cordage). The placement of this vessel with the Hell Island wares therefore is viewed as tentative. It may have been a less carefully manufactured Hell Island vessel representing a utilitarian item, but it may also have been an earlier ware, such as Wolfe Neck.

The paste in Vessel Lot H4 was not as well-blended or compact as the other Hell Island vessels, giving the impression that the vessel was especially fragile. This impression may also be in part due to the nature of the heavy tempering, especially the mica flaking. The cordage used for impressions on Vessel Lot H4 was also not as fine as the cordage observed on other vessels. The interior of Vessel Lot H4 was a darkened, reduced surface, while the exterior was highly oxidized indicating differential exposure to heat and oxygen.

The attributes exhibited by the Hell Island vessels suggested a departure from the rest of the assemblage. Whereas several of the other ware types such as Clay Tempered and Mockley displayed a seeming continuum of manufacturing attributes, the Hell Island ceramics were more varied. These vessels tended to be more heavily tempered, the walls were thinner, close weave fabric impressing and finer cord impressing were utilized, and both S and Z twist were present. Unfortunately, the sample was too limited to make any definite conclusions. Several of these traits continued into the small sample of Late Woodland wares.

**Townsend**

Late Woodland ceramics were not well represented at Hickory Bluff. Townsend ceramics were the most frequent Late Woodland ware with four vessel lots identified from a total of 70 sherds (Table 14.14). Townsend ceramics are defined by their shell temper, thin walls, and well-fired appearance. This ceramic type also displayed a wide-range of careful surface treatments and formalized decorative motifs. These vessels were coil constructed with thinner coils and conoidal shapes. Townsend vessels were well represented in the region.

The Townsend vessel lots from Hickory Bluff were all tempered with finely crushed shell. The shell had eroded out over time leaving slits and pores in the surfaces of the sherds. Vessel Lot T2 also contained gritty sand as a secondary temper, while the other three Townsend vessel lots included fine sand as an inclusion within the paste. Small iron oxide inclusions were also noted in Vessel Lots T1, T3, and HT1; however, their small size, low percentage, and uneven distribution suggested that these inclusions were incidental or part of the clay source used. Vessel Lot HT1 contained the highest proportion of iron oxide inclusions and had similar paste qualities as Mockley Vessel Lot MO3. In addition, Vessel Lot HT1 contained small

## Table 14.14 Summary of Vessel Lot Attributes for Townsend

| **Typology** | **Townsend** | | | |
|---|---|---|---|---|
| **Lot** | **T1** | **T2** | **T3** | **HT1** |
| **Paste** | | | | |
| ***Temper- Type*** | finely crushed shell | crushed shell and sand | finely crushed shell | crushed shell |
| ***Inclusions*** | fine sand/grit and iron oxide | none | fine sand and iron oxide | crushed quartz and fine sand/grit, iron oxide |
| ***Texture*** | smooth with slight grittiness | gritty and porous | smooth and pasty with slight roughness | slight roughness |
| **Surface Treatment** | | | | |
| ***Exterior*** | fabric impressed to lip edge, left undulating surface | fabric impressed | fabric impressed | fabric impressed then scraped with tool that left narrow parallel lines |
| ***Interior*** | smoothed plain with faint striation | smoothed plain | scraped, tool left narrow parallel lines in criss-cross pattern | smoothed or scraped in criss-cross pattern with tool that left narrow parallel lines |
| ***Cordage Characteristics*** | fine Z-twist; tightly woven | close woven, thin cordage | n/a | n/a |
| **Decoration** | interior of rim edges impressed with cord-wrapped sticks arranged vertically | None | None | None |
| **Form** | | | | |
| ***Lip*** | flattened, and wavy due to decoration | n/a | n/a | n/a |
| ***Rim*** | slightly inverted then straight taper to rim edge | n/a | n/a | n/a |
| ***Base/Body-Shape*** | n/a | n/a | n/a | n/a |
| ***Construction*** | coils | n/a | coils | narrow coils |

fragments of crushed quartz within its paste. The range of inclusions noted seemed to be more indicative of different clay sources. Only Vessel Lot T1 had a sherd submitted for thin section analysis, which showed similarity to one of the locally procured experimental clay tiles. This suggested that this vessel could have been locally produced. The similarity of the inclusions between this vessel lot and several of the other Townsend vessel lots, under visual inspection, suggested the possibility that a similar clay source was utilized.

Differences were also noted in the surface treatments exhibited by the Townsend vessel lots. Both Vessel Lots T1 and T2 exhibited fabric impressed exterior surfaces and smoothed plain interior surface treatments. The fabric used in both cases was close weave and formed with fine cordage, Z-twist in Vessel Lot T1. This vessel lot also was the only one of this type to contain formal decoration, also produced with fine Z-twist cordage. Vessel Lots T3 and HT1 were fabric-impressed on the exterior surface. However, the fabric used for the treatment was more of an open weave and had less fine cordage. It was tentatively identified as Z-twist on Vessel Lot T3, but weathering of the sherd made a definite identification difficult.

The interior surfaces of these two vessel lots were different from the other Townsend vessel lots. Both had been heavily scraped with a comb-like tool that left a criss-cross pattern of narrow, parallel lines across these surfaces. Vessel Lot HT1 also showed evidence of this scraping on the exterior surface. This scraping treatment was more similar to the treatment exhibited within the Clay Tempered ceramics and was not typical for the Townsend type.

The variations observed in Vessel Lots T3 and HT1 were important, as they were reminiscent of attributes commonly associated with Clay Tempered wares. The use of shell temper, paste characteristics, and thin walls was more typical of Townsend ceramics. An association between late Mockley vessels, which were also shell-tempered and had thinner walls, and Townsend vessels has been noted previously. In many respects, Townsend ware seems to be a refinement of Mockley traits and their similar geographic locations and co-occurrence supports this interpretation. Similarities between these two vessels and Clay Tempered ceramics tentatively suggested a continuity of these manufacturing attributes between these types, or perhaps a local variant of the more traditional wares. Unfortunately, the small size of the Late Woodland assemblage precluded more definitive analysis of these overlapping traits.

### Minguannan

Minguannan ware were another type of thin-walled vessels that represented the Late Woodland period. Like Townsend ware, Minguannan ceramics were thin-walled, had compact paste characteristics, and utilized fine cordage for a variety of surface treatments and decorative motifs. Crushed quartz and fine sand/grit were the main temper materials utilized for this type of ceramic. A total of 25 sherds and one vessel lot of Minguannan ceramics were recovered at Hickory Bluff (Table 14.15).

Vessel Lot MI1 was tempered with finely crushed quartz fragments of nearly uniform size and a minor amount of fine sand/grit, typical of the type. The paste was well blended and the sherds were very thin compared to the rest of the ceramic assemblage. Both the exterior and interior surfaces were evenly smoothed, which suggested attention to detail in the manufacture of the vessel. The vessel was decorated around the rim with a series of parallel, horizontal lines of impressed cords that were evenly spaced. The cordage utilized was of Z-twist and very fine. All of these traits were typical of Minguannan ceramics and Vessel Lot MI1 closely matched the characteristics used to define the ware.

**Table 14.15 Summary of Vessel Lot Attributes for Minguannan**

| **Typology** | **Minguannan** |
|---|---|
| **Lot** | **MI1** |
| **Paste** | |
| ***Temper- Type*** | crushed quartz |
| ***Inclusions*** | fine sand/grit |
| ***Texture*** | smooth with slight roughness |
| **Surface Treatment** | |
| ***Exterior*** | smoothed with faint drag marks |
| ***Interior*** | smoothed with faint drag marks |
| ***Cordage Characteristics*** | Z-twist, fine cordage |
| **Decoration** | Parallel lines of impressed cords, encircling the rim, horizontally |
| **Form** | |
| ***Lip*** | flattened |
| ***Rim*** | straight |
| ***Base/Body-Shape*** | n/a |
| ***Construction*** | n/a |

Similar to the association observed between Mockley and Townsend ceramics, an association between Hell Island and Minguannan ceramics has been observed. Both of these types utilized crushed quartz temper and similar vessel shapes and construction. Minguannan ceramics tended to be of better construction and display more involved formal decorative motifs than Hell Island vessels. The later Minguannan type seems to be a refinement of the earlier Hell Island ware. A similar geographic overlap in the northern Delmarva Peninsula and co-occurrence on sites further supported the notion. The Minguannan and Hell Island ceramics both displayed Z-twist and fine cordage, and tended not to share many similarities with the other earlier ceramic wares found at the site. The low numbers of Minguannan ceramics found did not allow for a fuller evaluation of the type and its relation to Hell Island ware.

## Untyped Lots

An additional five vessel lots that consisted of a total of 21 sherds were identified within the Hickory Bluff assemblage and unable to be assigned to any of the standard wares for the region (Table 14.16). Another 3,402 sherds also could not be confidently typed because of the small size or eroded condition. The five Untyped Vessel Lots (UT1, HUT1, HSH1, S1, and S2) exhibited characteristics of several different wares and may represent localized experimentation with more traditional ware manufacturing techniques, or specialized examples from within a ware.

## Table 14.16 Summary of Vessel Lot Attributes for Untyped Lots

| **Typology** | | | | | |
|---|---|---|---|---|---|
| **Lot** | **HUT1** | **UT1** | **HSH1** | **S1** | **S2** |
| **Paste** | | | | | |
| ***Temper- Type*** | none | none | crushed shell | sand - fine grained | sand - poorly sorted |
| ***Inclusions*** | fine sand, iron oxide/hematite fragments | fine sand and hematite fragments | sand/grit and 1 crushed quartz fragment | none | none |
| ***Texture*** | soft and pasty | pasty with slight roughness | pasty with slight roughness | gritty | gritty |
| **Surface Treatment** | | | | | |
| ***Exterior*** | impressed with close woven fabric | lightly cord impressed | unidentifiable impressions, smoothed over | incompletely smoothed with faint impressions | net-impressed, deep |
| ***Interior*** | smoothed | smoothed with faint impressions | scraped with tool that left narrow parallel lines, or unidentifiable impressions smoothed over | smoothed | net-impressed, lighly and partially smoothed over |
| ***Cordage Characteristics*** | final Z-twist | woven or twined into loose net/fabric formed with final S-twist | n/a | n/a | final S-twist |
| **Decoration** | none | none | none | none | none |
| **Form** | | | | | |
| ***Lip*** | rounded and cut deeply to form scallops along the edge | inverted at edge | n/a | n/a | n/a |
| ***Rim*** | tapered | tapered to lip | n/a | n/a | n/a |
| ***Base/Body-Shape*** | n/a | probable miniature | n/a | n/a | n/a |
| ***Construction*** | coils | probably modeled | coils | coils | coils |

Vessel Lot UT1 had a highly compacted paste that did not seem to include a tempering agent. Some small iron oxide particles and fine sand were included in the paste, but not in proportions that suggested their use as temper. In this regard, Vessel Lot UT1 was similar to Lot HUT1 and some of the clay-tempered lots that contained minimal amounts of visible temper. The vessel appeared modeled, however, and may have been a miniature vessel based on the curvature of the two sherds present. The exterior surface of the vessel was lightly impressed with S-twist cordage that may have been woven into a loose fabric.

Vessel Lot HUT1 contained several small iron oxide inclusions and a minor amount of fine sand in the paste, but these were likely inclusions within the clay source and not purposeful additions. As a result, the vessel appeared to be untempered. It had a smooth and pasty texture, with a moderately compacted paste. In this sense, Vessel Lot HUT1 was similar to several Clay Tempered ceramics that also were described as having little visible temper. Its surface treatments differed from the Clay Tempered ceramics, however, because it was impressed with a close weave fabric composed of fine, Z-twist cordage on its exterior surface. The interior surface of the vessel had been carefully smoothed. Both of these traits suggested more careful manufacture of the vessel. The lip of the vessel was rounded and the edge had been deeply cut with a tool to form scallops along the edge, which also distinguished this vessel from the assemblage.

A range of characteristics that crossed types was also exhibited by Vessel Lot HSH1. This vessel lot was predominately tempered with crushed shell that had leached out of the vessel body. Sand/grit and crushed quartz were included within the paste. The sherd thickness was considered too thin for a Mockley vessel. The exterior surface of the vessel exhibited unidentifiable impressions that had been smoothed over, while the interior surface had been repeatedly scraped with a tool that left a pattern of narrow parallel lines. This vessel lot was not defined within the known ware types.

Vessel Lots S1 and S2 shared some similarities to each other and to other ware types, but lacked attributes to be placed confidently within any known type. Both of these vessels were predominately tempered with sand. The sand used in Vessel Lot S1 was well sorted for fine size and included a few random larger pieces. Vessel Lot S2 contained poorly sorted sand within its paste. The exterior surface of Vessel Lot S1 was incompletely smoothed and the faint impressions that remained were not distinct enough to determine their type. The interior surface also was smoothed, and exhibited a few drag marks left by this process. Vessel Lot S2 had an exterior surface that was deeply net-impressed. The net used for this treatment was formed with a final S-twist. The interior surface was lightly net-impressed, and then partially smoothed over.

The well-sorted sand temper and thin walls of Vessel Lot S1 suggested that it was carefully manufactured. The surface treatments could not be determined, however, due to the eroded state of the sherds. Vessel Lot S1 was thinner and its sand temper was more carefully sorted than would be typical for Popes Creek ware. Vessel Lot S2, with its poorly sorted sand, thicker sherds, and net-impressions was more similar to Popes Creek. However, its amount of temper appeared lower and as a result, the vessel was less friable than typical for Popes Creek ceramics.

The identification of vessel lots that did not conform to the standard types typical of the region was significant for the site. Unfortunately, the counts were small and no reliably dated material was found in association with these vessels so they could not be placed in the chronological sequence.

**Type Evaluation Summary**

The ceramic analysis for Hickory Bluff provided a vast data set. For more detailed descriptions of the individual vessel lots consult Appendix I, the Ceramic Vessel Lot Descriptions. The information gathered from this analysis has wider implications for the site and the region. Ceramic refitting conducted in conjunction with the ceramic analysis was also used in detailed spatial analyses to provide information on site formation processes. Ceramic indicators were used as relative chronological indicators across the site and provided absolute dates obtained from residue gathered directly from ceramic sherds. Ceramic indicators were also used as possible indicators of feature associations and for artifact cluster analysis to establish site structure patterns.

On a broader level, information gathered from the Hickory Bluff ceramic assemblage has bearing on regional ceramic studies. Detailed analysis provided information on manufacturing techniques, temper and paste inclusions, cordage characteristics, and surface treatments. Some of the information was consistent and correlated well with patterns established in the region, while other results suggested more complexity and the possibility of local experimentation with dominant manufacturing techniques. Broader social implications, such as regional exchange systems and site preference models, will also be strengthened with the addition of the Hickory Bluff ceramic assemblage. The sheer size of the assemblage provided an important data set for the Delmarva Peninsula and the Mid-Atlantic Region.

Finally, special analyses were undertaken as part of the ceramic analysis and included thin section and residue analysis. The thin section analysis also incorporated comparison with locally derived clay source samples to assess the possibility of local ceramic manufacture. The results, although limited, highlighted the importance of such analysis to strengthen otherwise impressionistic interpretations about such questions. Analysis of residues on ceramics by AMS techniques provided important chronological information while botanical analysis of residues provided information about subsistence. These results were significant given the general lack of organic preservation at the site.